LEVEL # (12)

DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20084

DTNSRDC/SPD-0544-18

ANALYSIS OF WAKE SURVEY FOR TUNNEL-FIN AND ACCELERATING-FIN CONFIGURATIONS FOR THE NAVAL AUXILIARY OILER (AO 177) REPRESENTED BY MODEL 5326-1

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ANALYSIS OF WAKE SURVEY FOR TUNNEL-FIN AND ACCELERATING-FIN CONFIGURATIONS FOR THE NAVAL AUXILIARY OILER (AO 177) REPRESENTED BY MODEL 5326-1

by
GARY A. HAMPTON

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APRIL 1981

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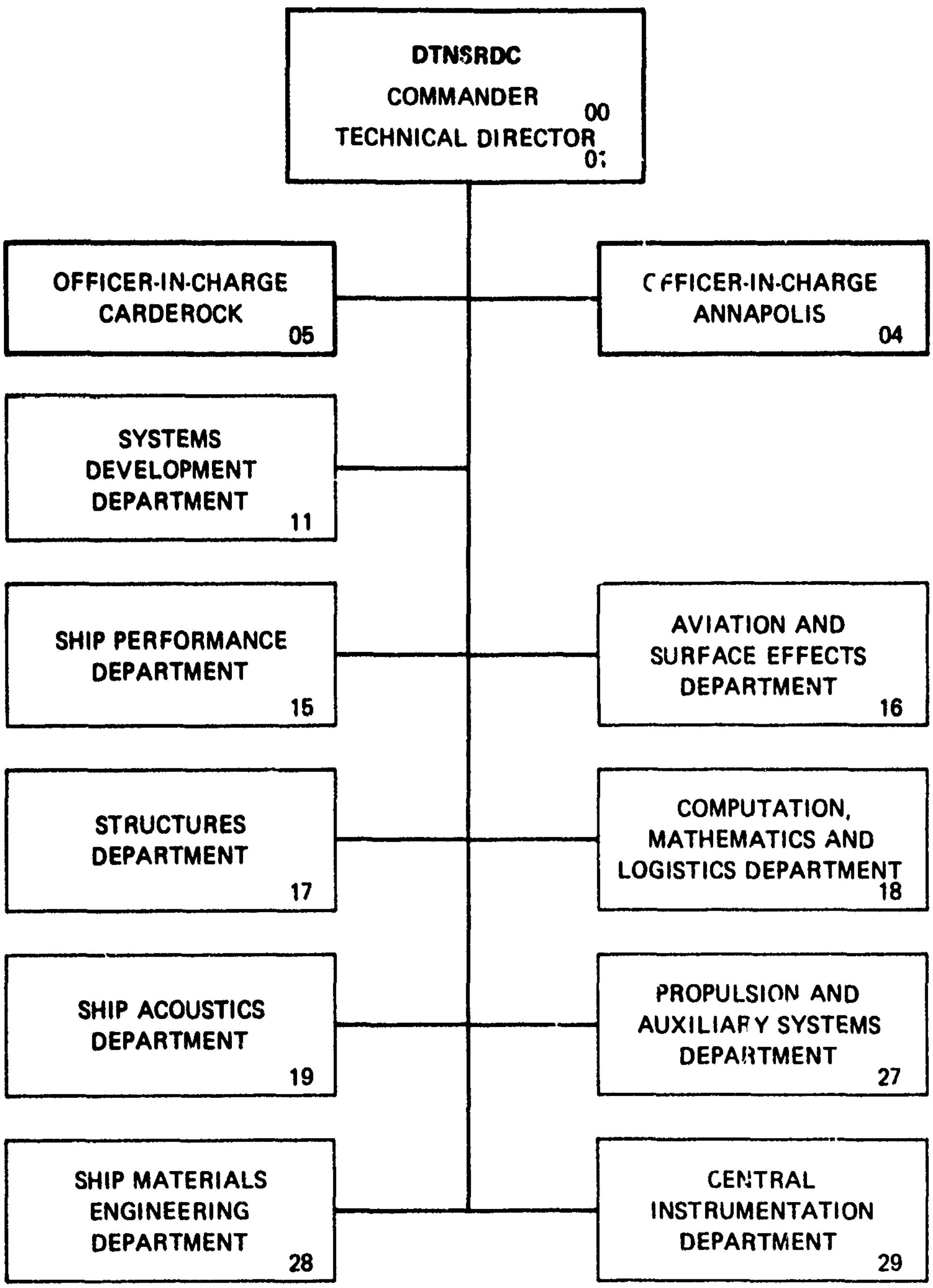

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER (14) DTNSRDC/SPD-0544-18	2. GOVT ACCESSION NO. AD-A098
3. RECIPIENT'S CATALOG NUMBER 060	
4. TITLE (and Subtitle) (6) ANALYSIS OF WAKE SURVEY FOR TUNNEL-FIN AND ACCELERATING-FIN CONFIGURATIONS FOR THE NAVAL AUXILIARY OILER AO-177 REPRESENTED BY MODEL 5326-1	5. TYPE OF REPORT & PERIOD COVERED (9) Final rept.,
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Gary A. Hampton	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS DAVID TAYLOR NAVAL SHIP R&D CENTER SHIP PERFORMANCE DEPARTMENT BETHESDA, MD. 20084 389694	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS P00R145 P00R162 1-1532-115-40 1-1532-116-40
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Sea Systems Command (3213) Washington, D.C. 20367 (12) 163	12. REPORT DATE (11) Apr[redacted]81
	13. NUMBER OF PAGES 172
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

DISTRIBUTION UNLIMITED; APPROVED FOR PUBLIC RELEASE

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Tunnel-Fins
Accelerating-Fins
Wake Survey

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Wake survey experiments were conducted with Model 5326-1 to aid in the identification and resolution of the propeller cavitation and airborne noise problem experienced by the Auxiliary Oiler AO-177 and to validate possible remedies. The experimental program involved the evaluation of three tunnel-fin configurations and one accelerating-fin configuration fitted to the stern of the model. The results of the wake survey experiments show that the flow into the propeller plane was improved by the addition of any of the four fins.

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NOTATION

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
D	—	Propeller diameter
J_V	J_V	Apparent advance coefficient $J_V = \frac{V}{nD}$ (dimensionless)
N	N	Harmonic number
n	—	Propeller revolutions
P	P	Pressure
r/R or x	Radius or RAD.	Distance (r) from the propeller axis expressed as a ratio of the propeller radius (R)
V	V	Actual model or ship velocity
$V_r(x,\theta)$	VR	Radial component of the fluid velocity for a given point (positive toward the shaft centerline)
$V_r(x,\theta)/V$	VR/V	Radial velocity component ratio for a given point
$\bar{V}_r(x)/V$	VRBAR	Mean radial velocity component ratio for a given radius
$V_t(x,\theta)$	VT	Tangential component of the fluid velocity for a given point (positive in a counterclockwise direction looking forward)
$V_t(x,\theta)/V$	VT/V	Tangential velocity component ratio for a given point
$\bar{V}_t(x)/V$	VTBAR	Mean tangential velocity component ratio for a given radius
$(\tilde{V}_t(x)/V)_N$	AMPLITUDE	Amplitude (B_N for single screw symmetric; C_N otherwise) of Nth harmonic of the tangential velocity component ratio for a given radius
$V_x(x,\theta)$	VX	Longitudinal (normal to the plane of survey) component of the fluid velocity for a given point (positive in the astern direction)
$V_x(x,\theta)/V$	VX/V	Longitudinal velocity component ratio for a given point
$\bar{V}_x(x)/V$	VXBAR	Mean longitudinal velocity component ratio for a given radius
$(\tilde{V}_x(x)/V)_N$	AMPLITUDE	Amplitude (A_N for single screw symmetric; C_N otherwise) of Nth harmonic of the longitudinal velocity component ratio for a given radius

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
$1-w(x)$	1-WX	Volumetric mean velocity ratio from the hub to a given radius $$1-w(r/R) = \left[\frac{2\cdot\int_{r_{hub}/R}^{r/R}(\bar{V}_{x_c}(x)/V)\cdot x\cdot dx}{(r/R)^2-(r_{hub}/R)^2}\right]$$ where $\bar{V}_{x_c}(x)/V = \int_0^{2\pi}\left[\frac{V_{x_c}(x,\theta)}{2\pi V}\right]d\theta$ and $V_{x_c}(x,\theta)/V = (V_x(x,\theta)/V) - (V_t(x,\theta)/V)\tan(\beta(x,\theta))$
$1-w_v(x)$	1-WVX	Volumetric mean velocity ratio from the hub to a given radius (without the tangential velocity correction) $$1-w(r/R) = \left[\frac{2\cdot\int_{r_{hub}/R}^{r/R}(\bar{V}_x(x)/V)\cdot x\cdot dx}{(r/R)^2-(r_{hub}/R)^2}\right]$$
$\bar{\beta}(x)$	BBAR	Mean advance angle in degrees for given radius
$+\Delta\beta$	BPOS	Variation of the maximum advance angle from the mean for a given radius
$-\Delta\beta$	BNEG	Variation of the minimum advance angle from the mean for a given radius

ABSTRACT

Wake survey experiments were conducted with Model 5325-1 to aid in the identification and resolution of the propeller cavitation and airborne noise problem experienced by the Auxiliary Oiler AO-177 and to validate possible remedies. The experimental program involved the evaluation of three tunnel-fin configurations and one accelerating-fin configuration fitted to the stern of the model. The results of the wake survey experiments show that the flow into the propeller plane was improved by the addition of any of the four fins.

ADMINISTRATIVE INFORMATION

This work was funded by the Naval Sea Systems Command (NAVSEA 3213), and was carried out under NAVSEA Project Orders POOR145 and POOR162, and DTNSRDC Work Unit Numbers 1-1532-115-40 and 1-1532-116-40.

INTRODUCTION

At the request of the Naval Sea Systems Command (NAVSEA 3213), a model experimental program was carried out at the David W. Taylor Naval Ship Research and Development Center to help in the resolution of the propeller cavitation and airborne noise problem experienced by the Auxiliary Oiler AO-177.

The AO-177 has a very fine, thin stern, providing a highly reduced longitudinal velocity in the vicinty of the top of the propeller plane. Such a phenomenon is likely to cause unsteady cavitation on the propeller blades, which in turn may cause excessive noise and local vibration problems in the stern area of the ship. One proposed remedy was to improve the flow into the propeller by fins installed at the stern of the ship. It was considered that the fins will guide more flow into the propeller plane, reducing or diffusing the severe nonuniformity of the wake distribution.

Four different fin configurations were designed and an experimental program was carried out to validate their effectiveness. The experiments involved visual flow observations, resistance and propulsion experiments and wake survey experiments. The results of the flow observations were published in reference 1*. This report describes the results of the wake survey experiments. The results of the resistance and propulsion experiments will be published in a following report.

* References are listed on page 6.

MODEL DESCRIPTION

Three tunnel-fin designs were constructed and fitted to an existing model (Model 5326-1) of the AO-177, according to plans furnished by NAVSEA, entitled, "Flow Improvement Fin", and designated Configuration 1 (SK 3213-0026), Configuration 2 (SK 3213-0027), and Configuration 3 (SK 3213-0028). An accelerating fin was constructed by the Swedish Center for Maritime Research (SSPA) according to plans entitled, "U.S. Navy Fleet Oiler Proposal to Stern Fins," File No. 2564. The accelerating-fin is designated as Configuration 4.

Model 5326-1 representing the Auxiliary Oiler AO-177 was previously constructed to a linear scale ratio of 25.682. The model was fitted with the same bilge keel which was on the model during the previous wake survey experiments. Illustrations of the fins and experimental radii are shown in Figure 1 (Configuration 1), Figure 2 (Configuration 2), Figure 3 (Configuration 3) and Figure 4 (Configuration 4). Fitting room photographs of the fins attached to the model are presented in Figures 5 through 8.

EXPERIMENTAL PROCEDURES

During the wake survey, the various velocity components were obtained with DTNSRDC pitot tube rake 8 connected to differential pressure transducers. This rake consists of five 5-hole spherically headed pitot tubes mounted in a foil shaped housing. A photograph of the model stern with the rake attached is shown in Figure 9. The pitot tubes were located in the propeller plane 4.62 feet (1.41 m) in ship scale aft of station 19½. The diameter of the ship propeller is 21 feet. The radial location of the pitot tubes expressed as fractions of the propeller diameter (r/R) are, respectively, 0.359, 0.556, 0.775, 1.017 and 1.178.

The shape of the pitot-tube rake is such that, while the model is being towed, the rake may cause variations in trim at different angular positions. In order to maintain the natural trim throughout each survey, the model was towed at a speed corresponding to 20 knots full scale, free to assume a correct trim with the rake in the zero degree position. The model was then locked in that trim for that particular experiment Trim values for the wake survey conditions will be included in the resistance and propulsion report.

An apparent advance coefficient (J_V) of 1.01 based on full-scale RPM at 20 knots was used in the calculation of the advance angles. The basin water temperature throughout the survey was 71° F (21° C).

DATA ACCURACY

The accuracy of the wake survey apparatus is estimated to be ±2 percent in measuring the longitudinal velocity component ratio (VX/V), except in locations where steep velocity gradients occur. Data accuracy in these locations are expected to be less than in regions of a slowly changing velocity field.

The wake velocity components typically show some slight transverse asymmetry, evident in the circumferential distribution figures. Similar asymmetries can be seen in any full-disc presentations of single-screw model wake data. Such differences are considered to be insignificant.

PRESENTATION OF DATA

It was necessary to confirm the repeatability and also to establish a base on which to correlate the wake survey data for the series of experiments. Therefore, Experiment 1 Repeat (October 1980) was conducted having the same experimental conditions as the previously conducted Experiment 1 (August 1980)[2]. The experimental conditions included a trim of 1 foot (0.305 m) by the bow full-scale, the equivalent full-scale displacement of 26,390 tons (26 810 metric tons) and without fins. These results are presented graphically for each radius in Figures 10 through 14 as composite plots of the velocity component ratios.

Experiment 1 (October 1980) without fins is also compared to tunnel-fin Configuration 1 (NAVY) and accelerating-fin Configuration 4 (SSPA) at a trim of 1 foot (0.305 m) by the bow full-scale and an equivalent full-scale displacement of 26,390 tons (26 810 metric tons). The velocity component ratios are presented in Figures 15 through 19 for each radii.

The wake survey results for the three Navy tunnel-fins, Configuration 1, Configuration 2, Configuration 3 are presented as composite plots in Figures 20 through 24 at the trim of 1 foot (0.305 m) by the bow full-scale and the equivalent full-scale displacement of 26,390 tons (26 810 metric tons) for each experimental radii. Tabulated results of the mean velocity component ratios and other derived quantities for the no fin configuration, Configuration 1 (NAVY, Configuration 2 (NAVY),

Configuration 3 (NAVY) and Configuration 4 (SSPA) are presented in Table 1 (page 46).

Velocity component ratios for tunnel-fin Configuration 1 (NAVY) and accelerating-fin Configuration 4 (SSPA) are compared in Figures 25 through 28 with the model trimmed 3.75 feet (1.143 m) by the stern ship scale and at the equivalent ship displacement of 17,270 tons (17 550 metric tons). The radius of 1.178 is not presented because pitot tube number 5 was out of the water when the model was towed at the equivalent ship speed of 20 knots. Tabulated results of the mean velocity component ratios and other derived quantitites are presented in Table 2 (page 48).

A variation in fin alignment was also investigated by conducting an experiment with tunnel-fin Configuration 3 (NAVY) rotated up 2.5 degrees, leading edge raised 0.75 inches (1.91 cm) in model scale. This experiment is compared to tunnel-fin Configuration 3 (NAVY) as normally attached to the model at a trim of 1.0 feet (0.305 m) by the bow full-scale and an equivalent full-scale displacement of 26,390 tons (26 810 metric tons). The velocity component ratios are presented as composite plots in Figures 29 through 33. Tabulated results of the mean velocity component ratios and other derived quantities are presented in Table 3 (page 49).

A listing of the experimental configurations and corresponding ship values is given in Table 4 (page 50).

The results for each of the wake survey experiments are given separately in Appendices A through H, including the following graphs and tables:

(1) Velocity component ratios at each radius.

(2) Radial distribution of the mean velocity component ratios.

(3) Radial distribution of the mean advance angle and the maximum variations of the advance angle.

(4) A listing of the mean velocity component ratios, the mean advance angles and other derived quantities.

(5) Harmonic analysis of the longitudinal velocity component ratios at the experimental and interpolated radii.

(6) Harmonic analysis of the tangential velocity component ratios at the experimental and interpolated radii.

(7) A listing of the input data.

DISCUSSION OF RESULTS

When comparing the results for Experiment 1 Repeat (October 1980, no-fins) with the results for Experiment 1 (August 1980, no-fins), the data is within the expected limits of repeatability, $\pm$ 2 percent. In the propeller plane the area of greatest concern is the area where the longitudinal velocity (VX/V) becomes minimum causing the inflow to be non-uniform. This area is around the zero degree position, (i.e., 12 o'clock position). Based on the longitudinal flow (VX,V), the addition of any of the four fin configurations improved the flow into the propeller plane in this critical area. The differences in longitudinal velocities (VX/V) when comparing the results for the different fin configurations are minimal. Thus, instead of showing the results of individual fins, the results of four fins have been averaged and are presented in Figure 34 (page 41) to show a typical wake modification achievable by using any one of the four fins investigated. It is clear from this figure that a fin improves the wake by reducing the velocity defect in the region near the 12 o'clock position. Further analysis and evaluation of the impact of such wake improvement on the propeller cavitation and airborne noise will be reported in a later report.

REFERENCES

1. Hampton, Gary A., "Investigations of Underwater Flow Patterns for Three Tunnel-Fin Configurations for the Naval Auxiliary Oiler (AO-177) Represented by Model 5326-1", DTNSRDC Report SPD-544-17, (February 1981).

2. Wilson, M. B. and Hampton, G. A., "Measurements of the Effect on Trim on the Nominal Wake of the Naval Auxiliary Oiler AO-177", DTNSRDC Report SPD-544-19, (March 1981).

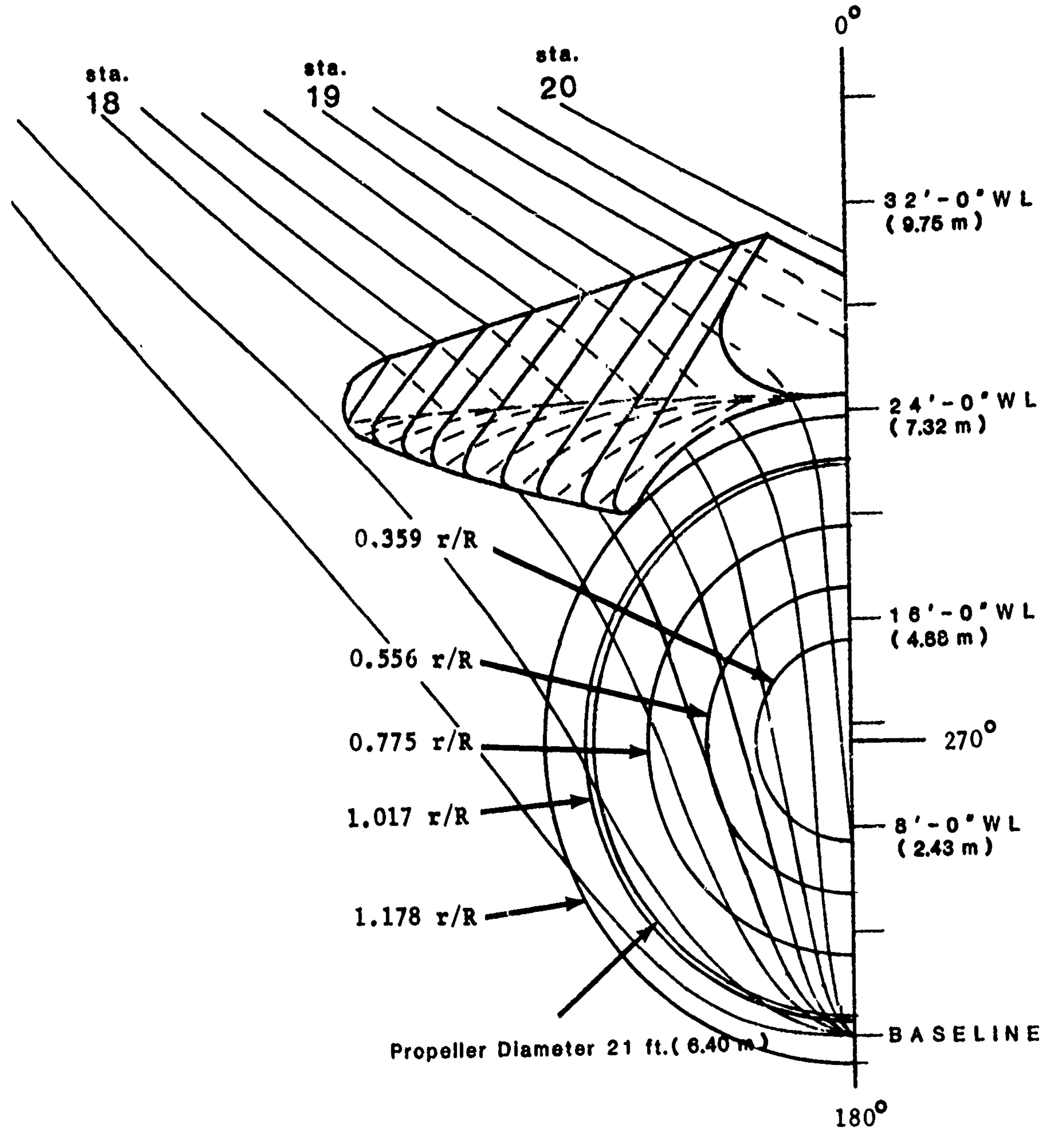


Figure 1 - Body Plan with Tunnel-fin Configuration 1 (NAVY) and Experimental Radii

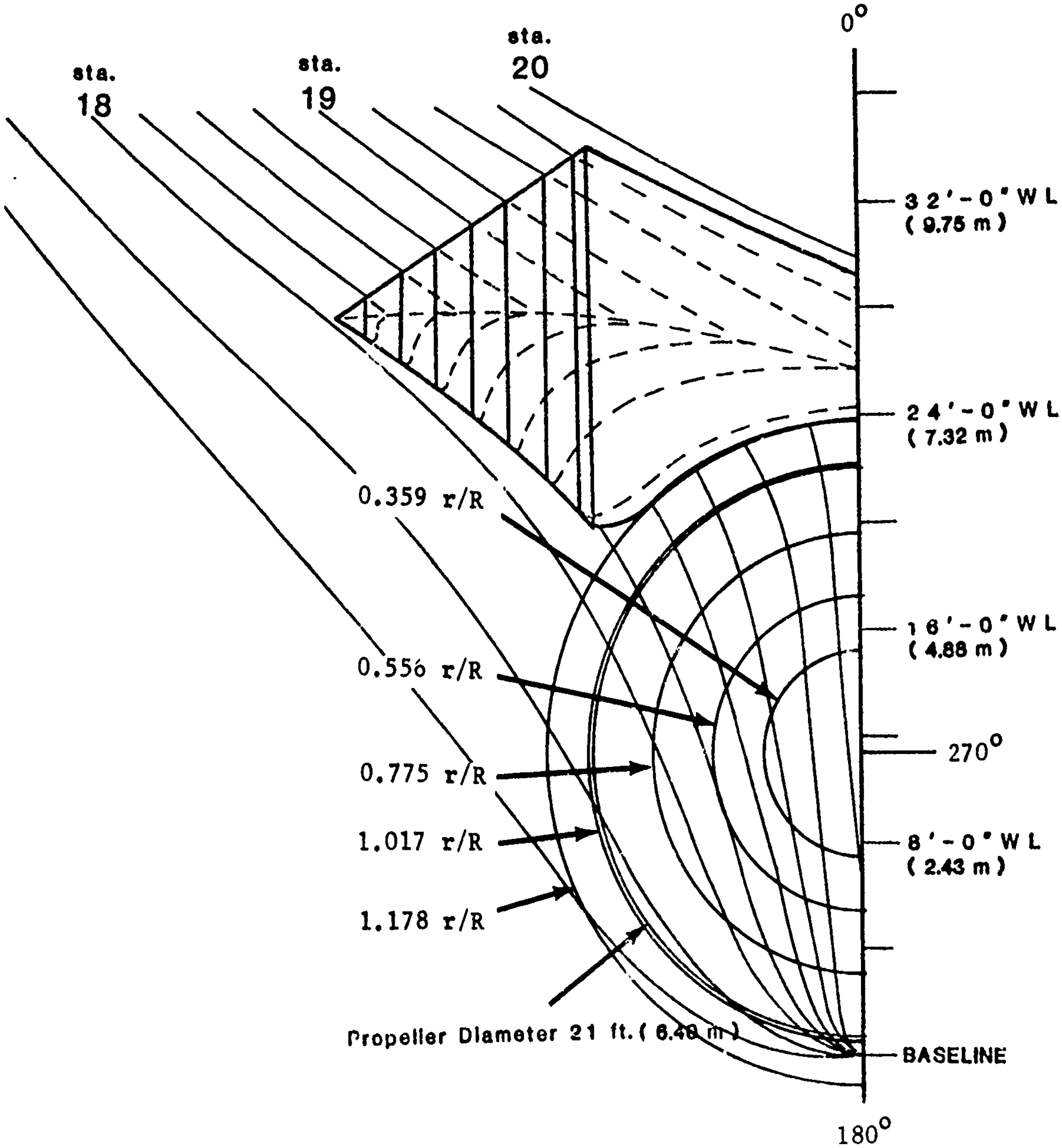


Figure 2 - Body Plan with Tunnel-fin Configuration 2 (NAVY) and Experimental Radii

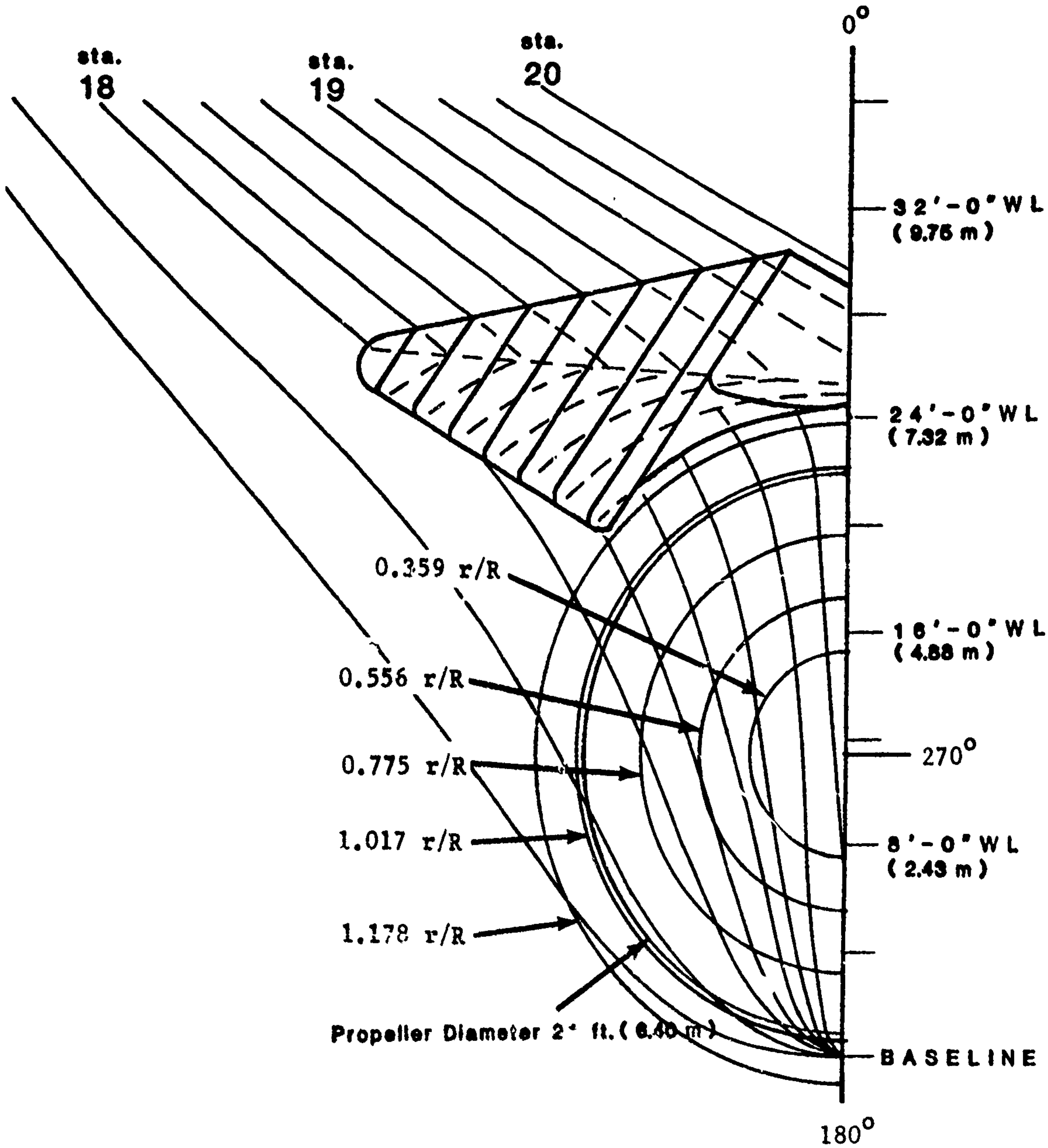


Figure 3 - Body Plan with Tunnel-fin Configuration 3 (NAVY) and Experimental Radii

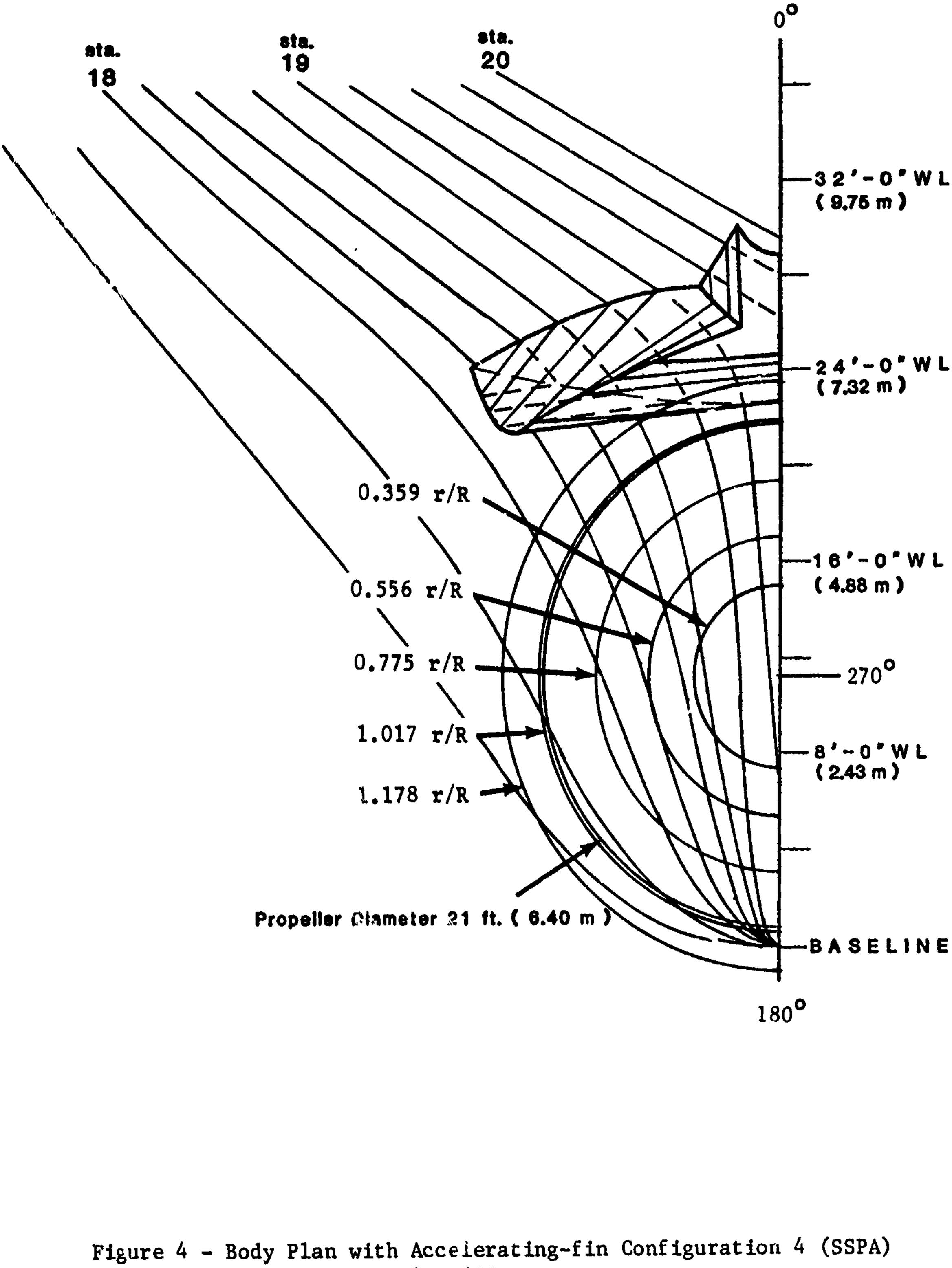


Figure 4 - Body Plan with Accelerating-fin Configuration 4 (SSPA) and Experimental Radii

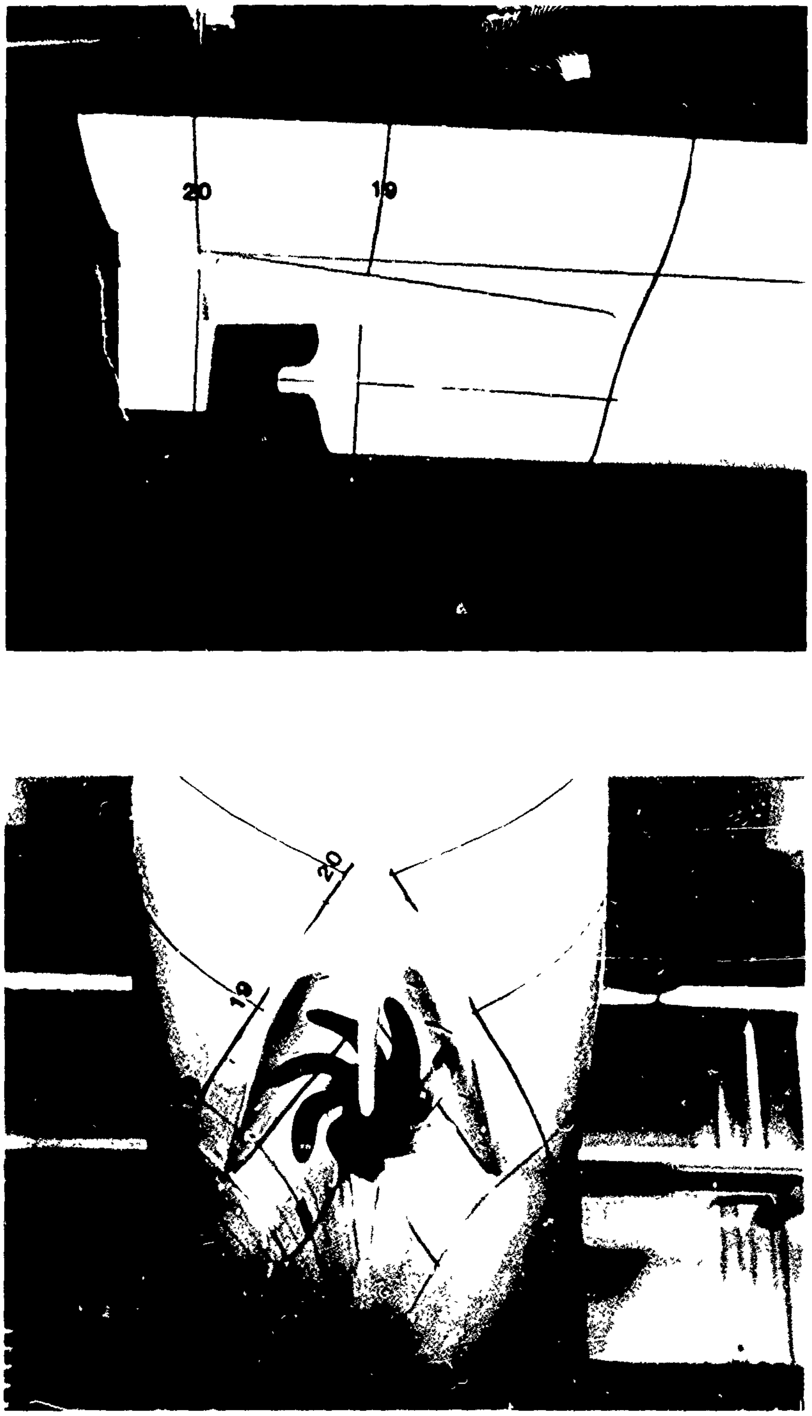


Figure 5 - Fitting Room Photographs of Tunnel-fin Configuration 1
Attached to Model

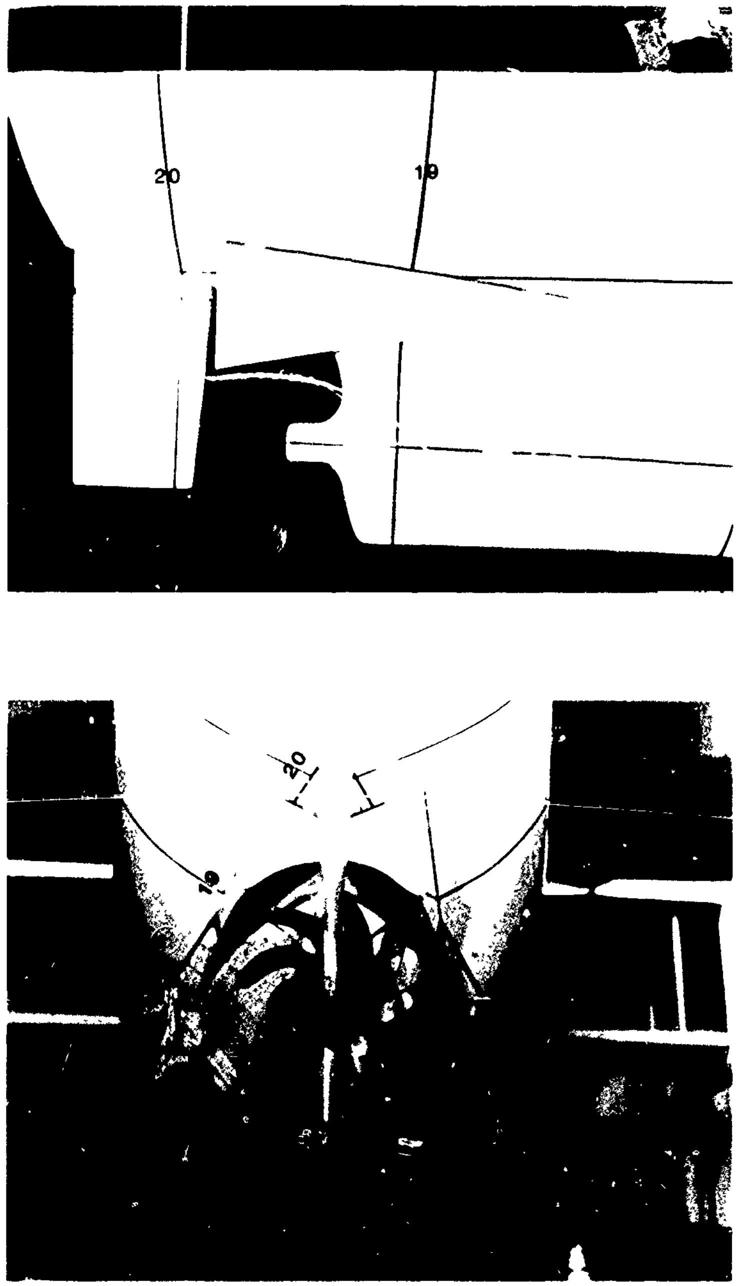


Figure 6 - Fitting Room Photographs of Tunnel-fin Configuration 2 Attached to Model

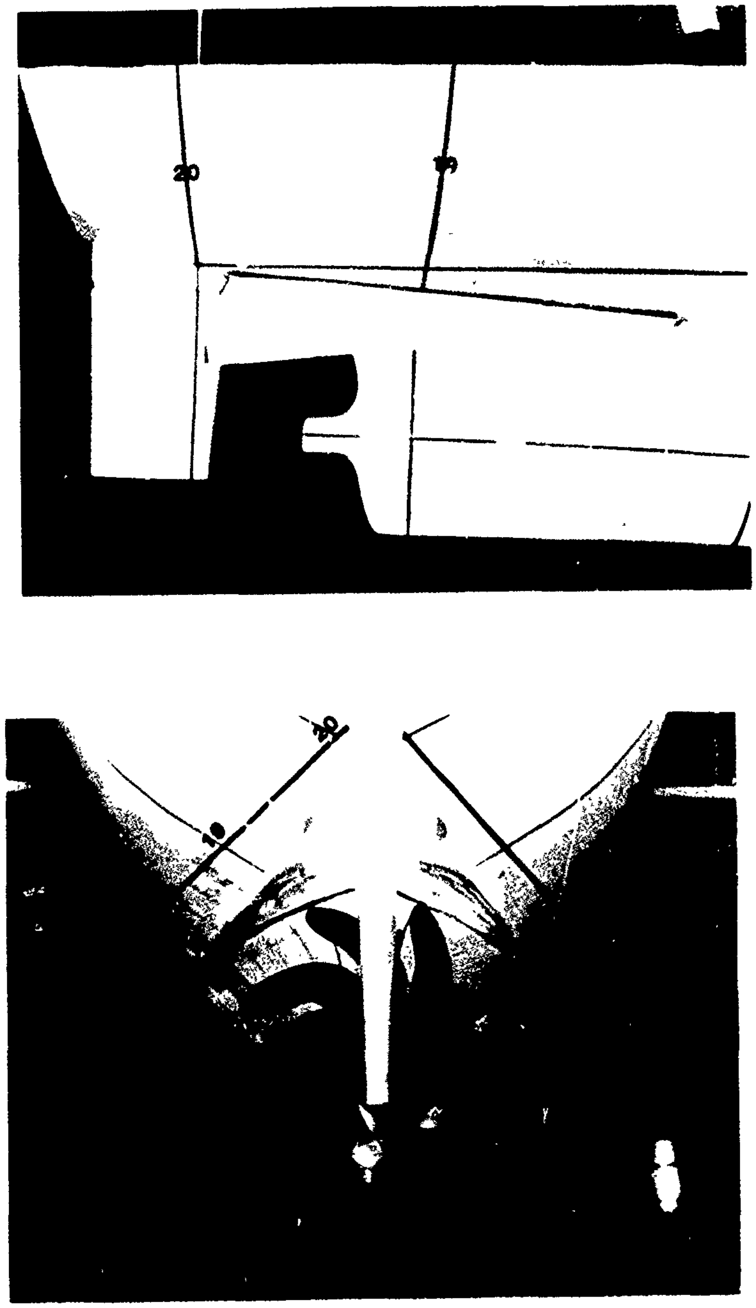


Figure 7 - Fitting Room Photographs of Tunnel-fin Configuration 3
Attached to Model

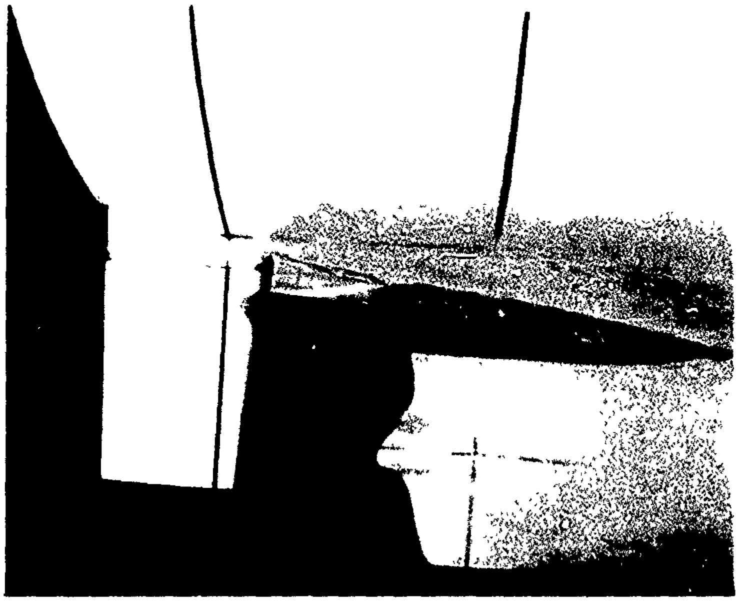
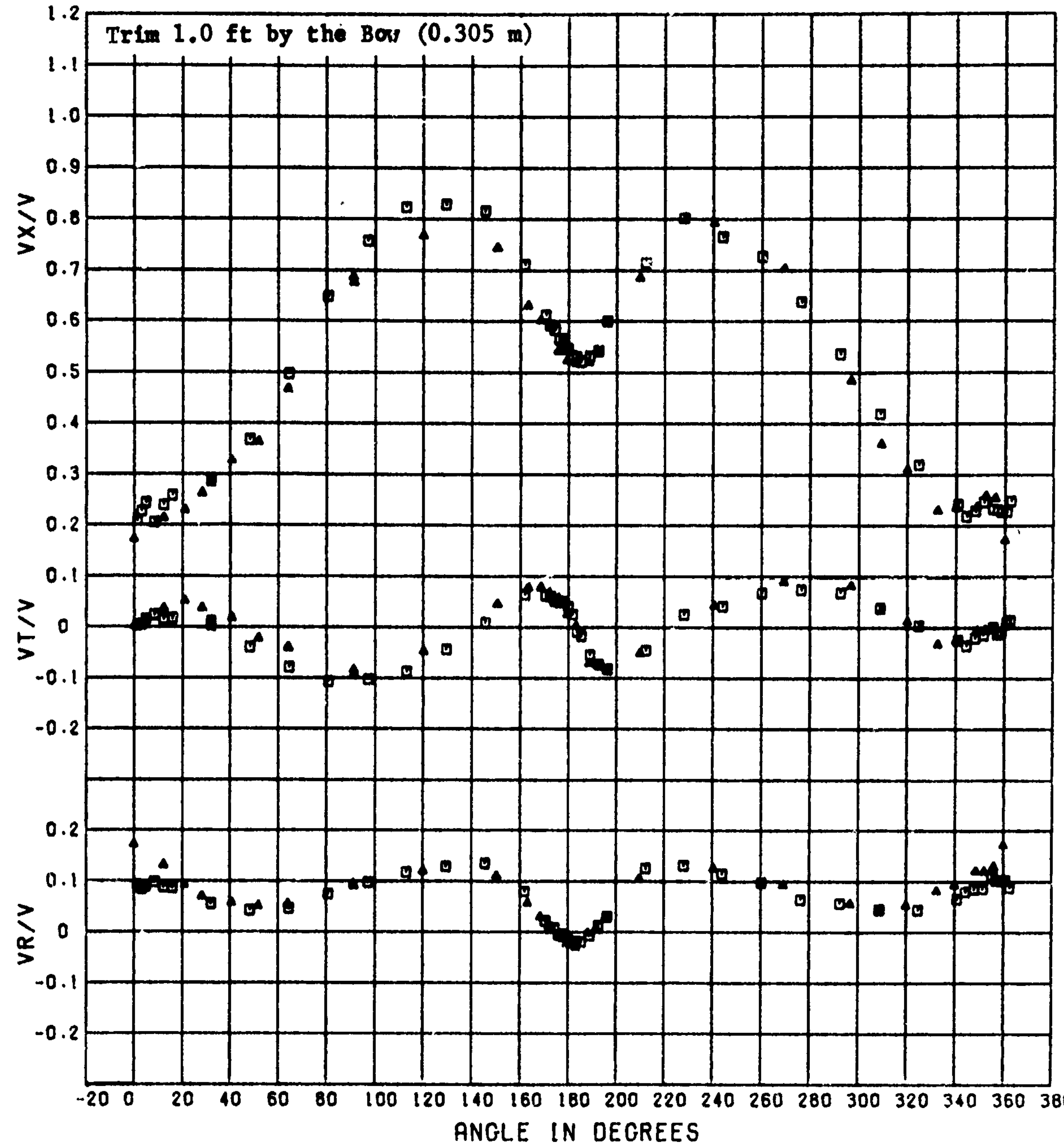


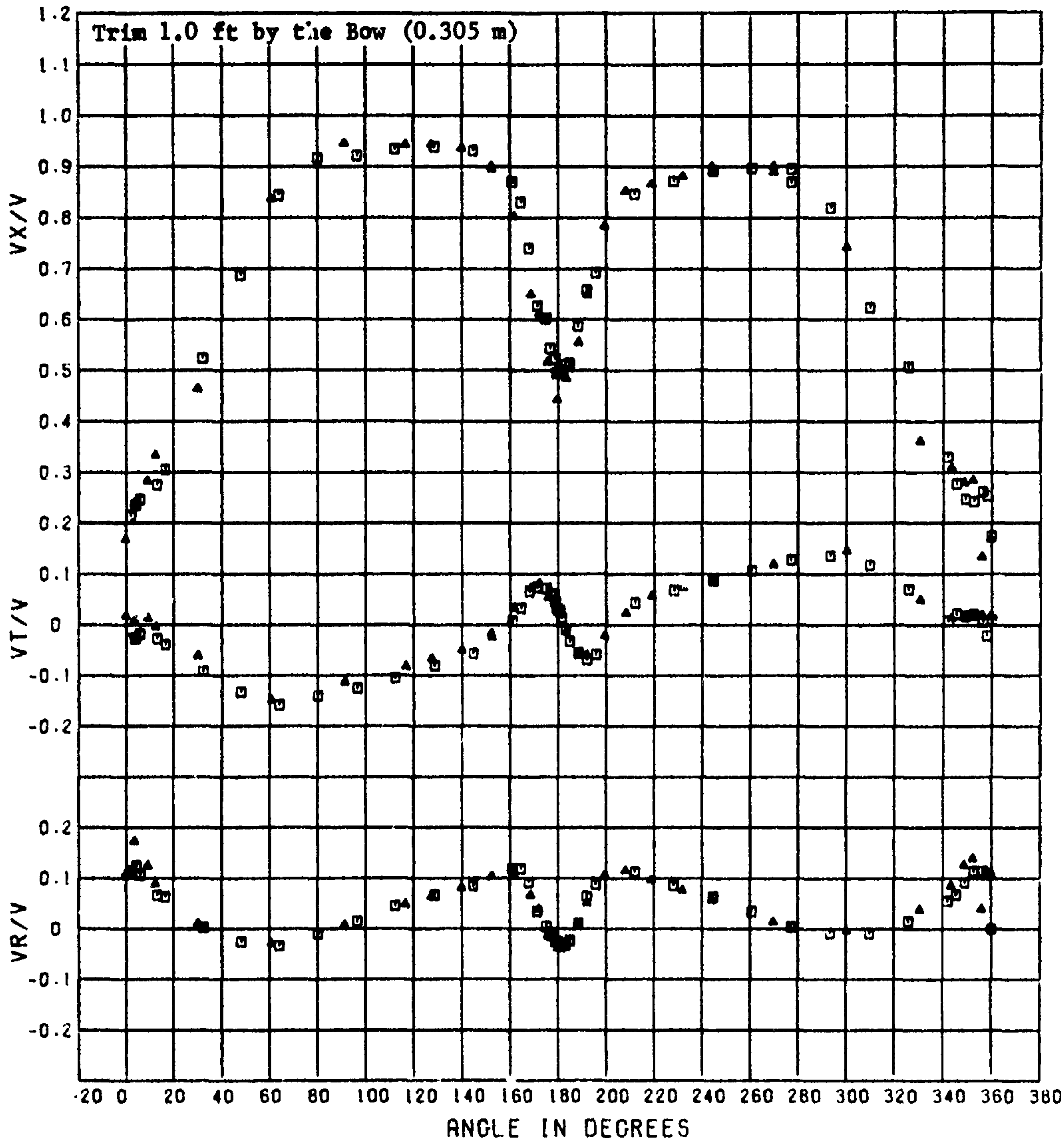
Figure 8 - Fitting Room Photographs of Accelerating-fin Configuration 4
Attached to Model

Figure 9 - Stern of Model 5326-1 with Rake Attached



□ Experiment No. 1 without fins
▲ Experiment No. 1 Repeat without fins

Figure 10 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios without Fins Experiment 1 (8/80) and Experiment 1 Repeat (10/80) at a Radius Ratio of 0.359. Displacement 26,390 tons (26 810 metric tons)



□ Experiment No. 1 without fins
▲ Experiment no. 1 Repeat without fins

Figure 11 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios without Fins Experiment 1 (8/80) and Experiment 1 Repeat (10/80) at a Radius Ratio of 0.556. Displacement 26,390 tons (26 810 metric tons)

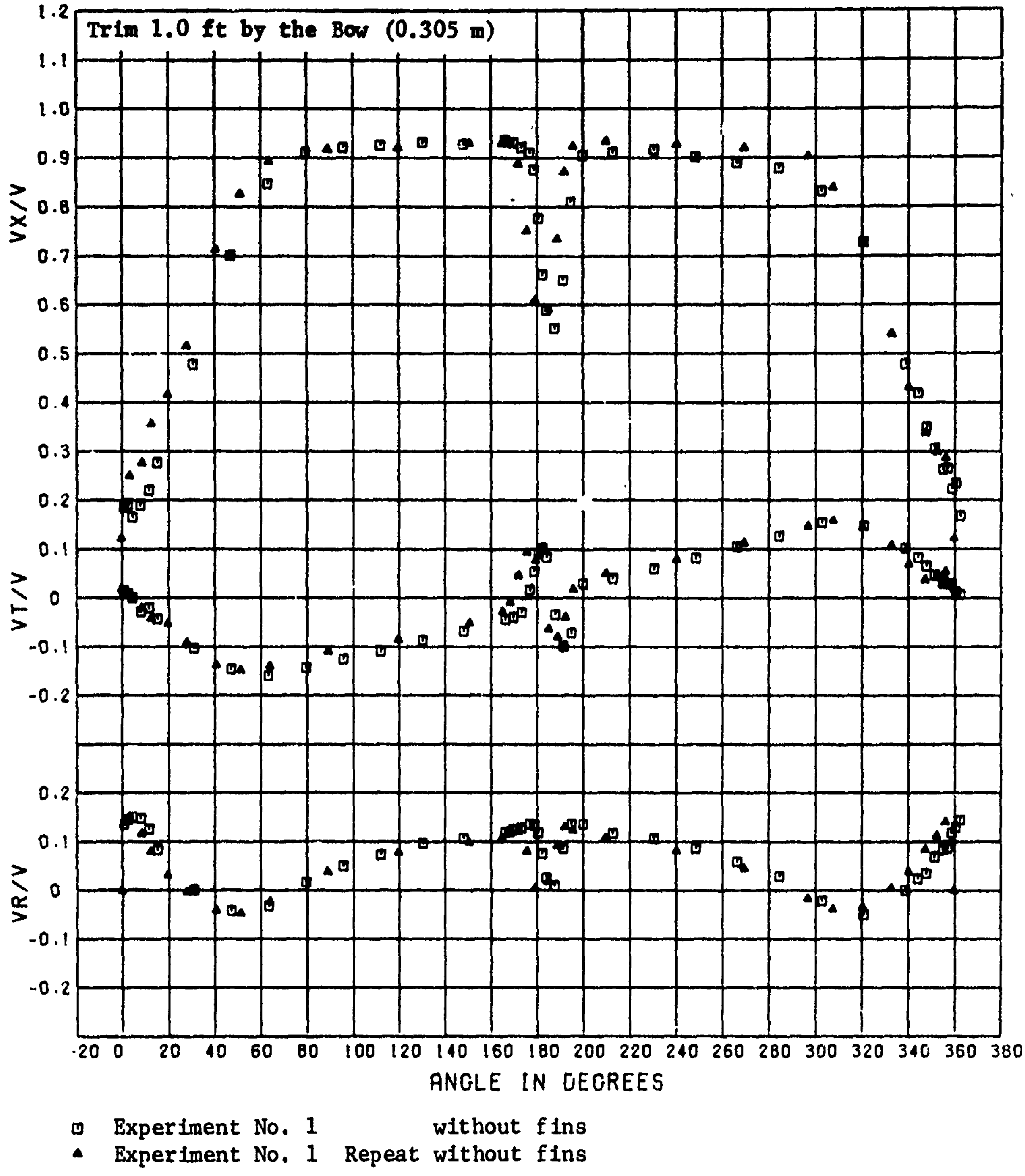
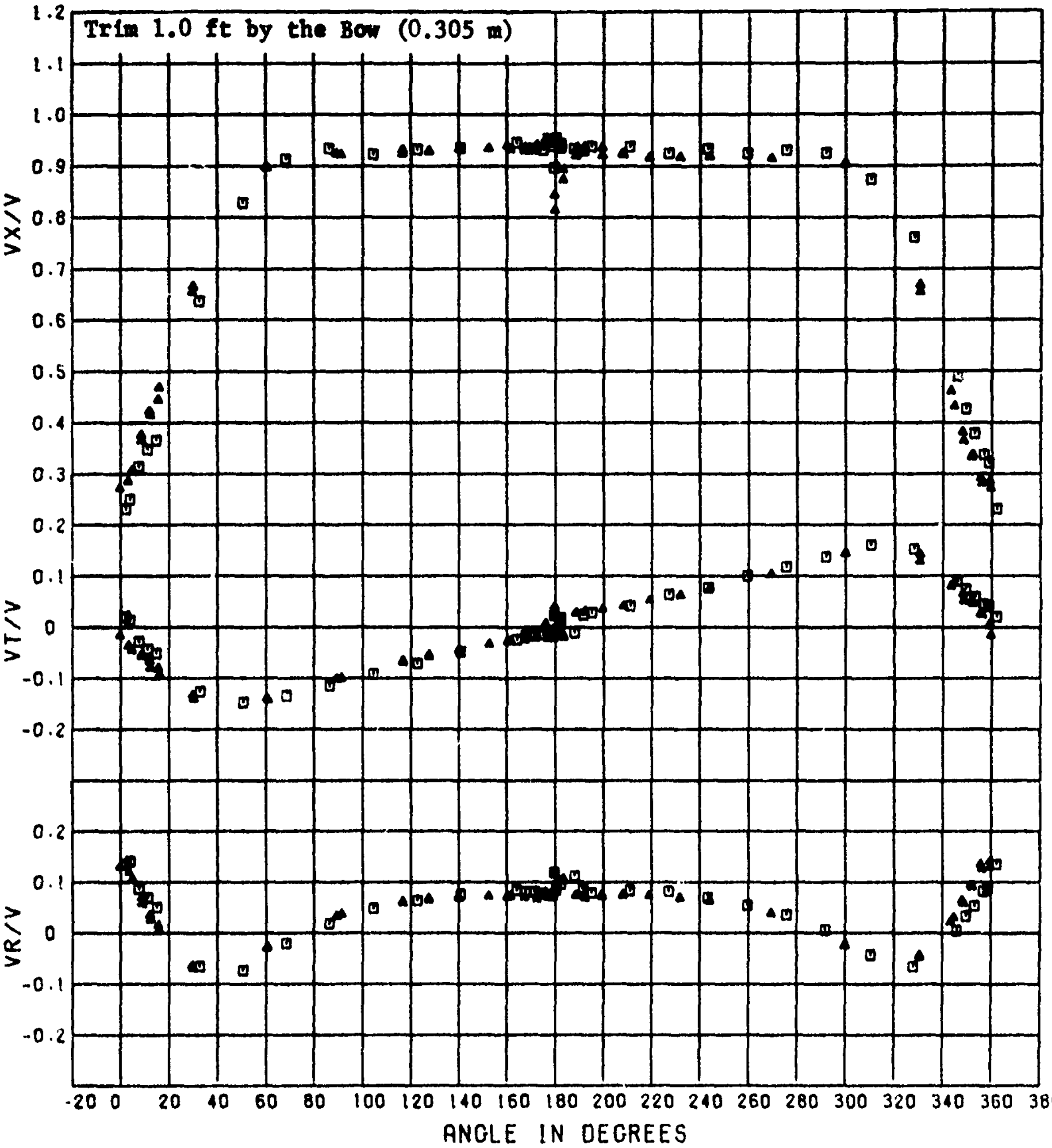


Figure 12 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios without Fins Experiment 1 (8/80) and Experiment 1 Repeat (10/80) at a Radius Ratio of 0.775. Displacement 26,390 tons (26 810 metric tons)



□ Experiment No. 1 without fins
▲ Experiment No. 1 Repeat without fins

Figure 13 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios without Fins Experiment 1 (8/80) and Experiment 1 Repeat (10/80) at a Radius Ratio of 1.017. Displacement 26,390 tons (26 810 metric tons)

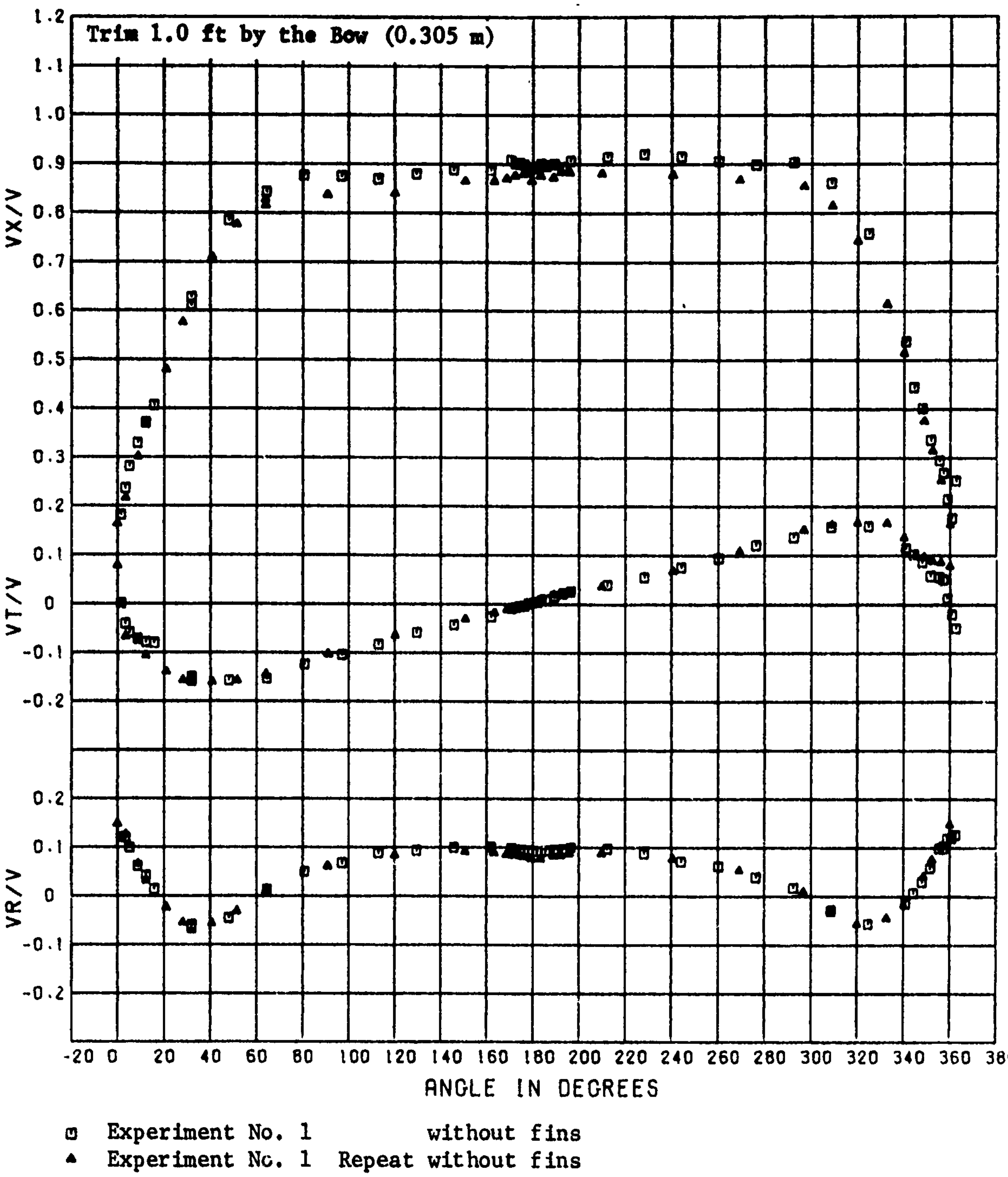


Figure 14 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios without Fins Experiment 1 (8/80) and Experiment 1 Repeat (10/80) at a Radius Ratio of 1.178. Displacement 26,390 tons (26 810 metric tons)

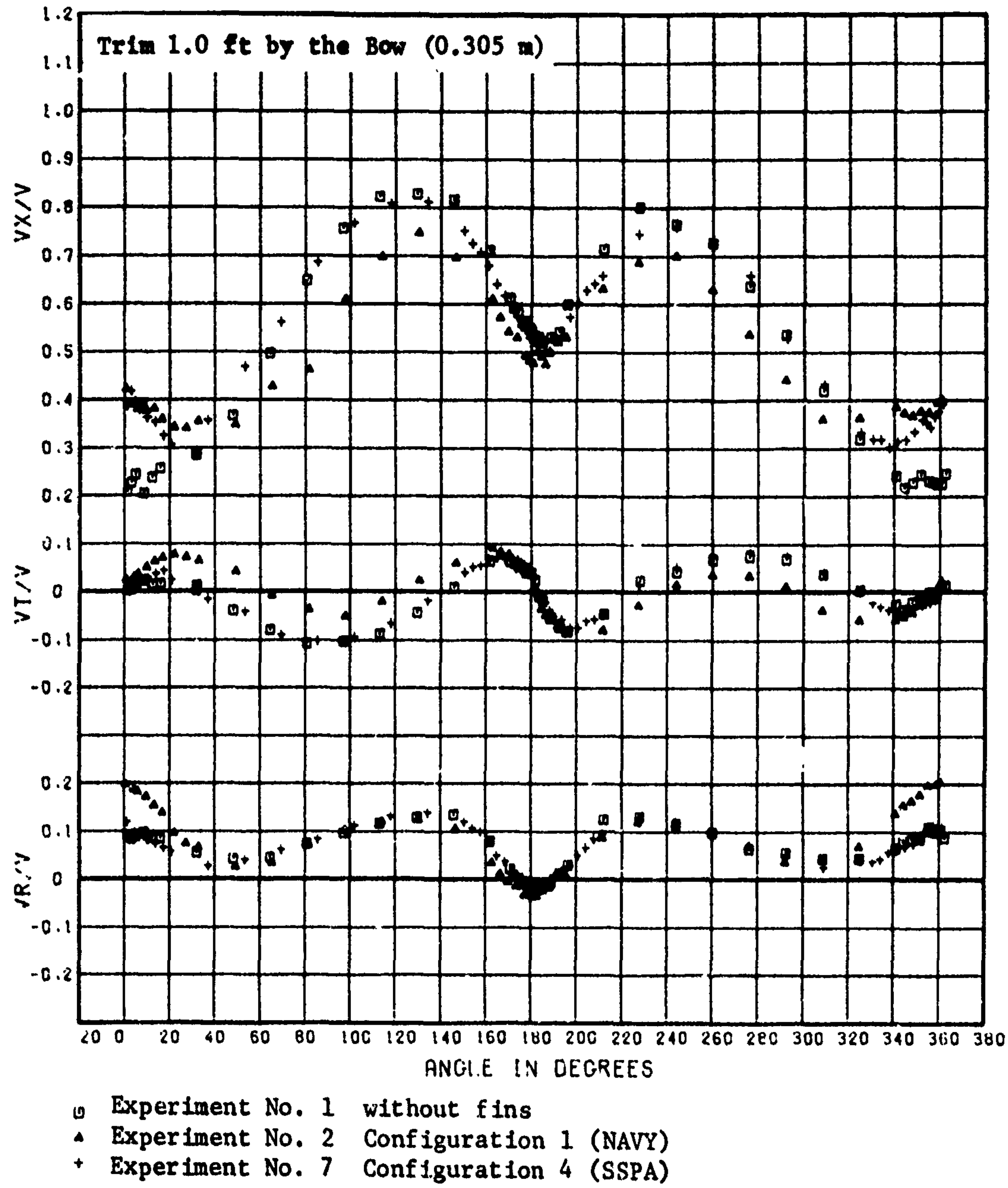
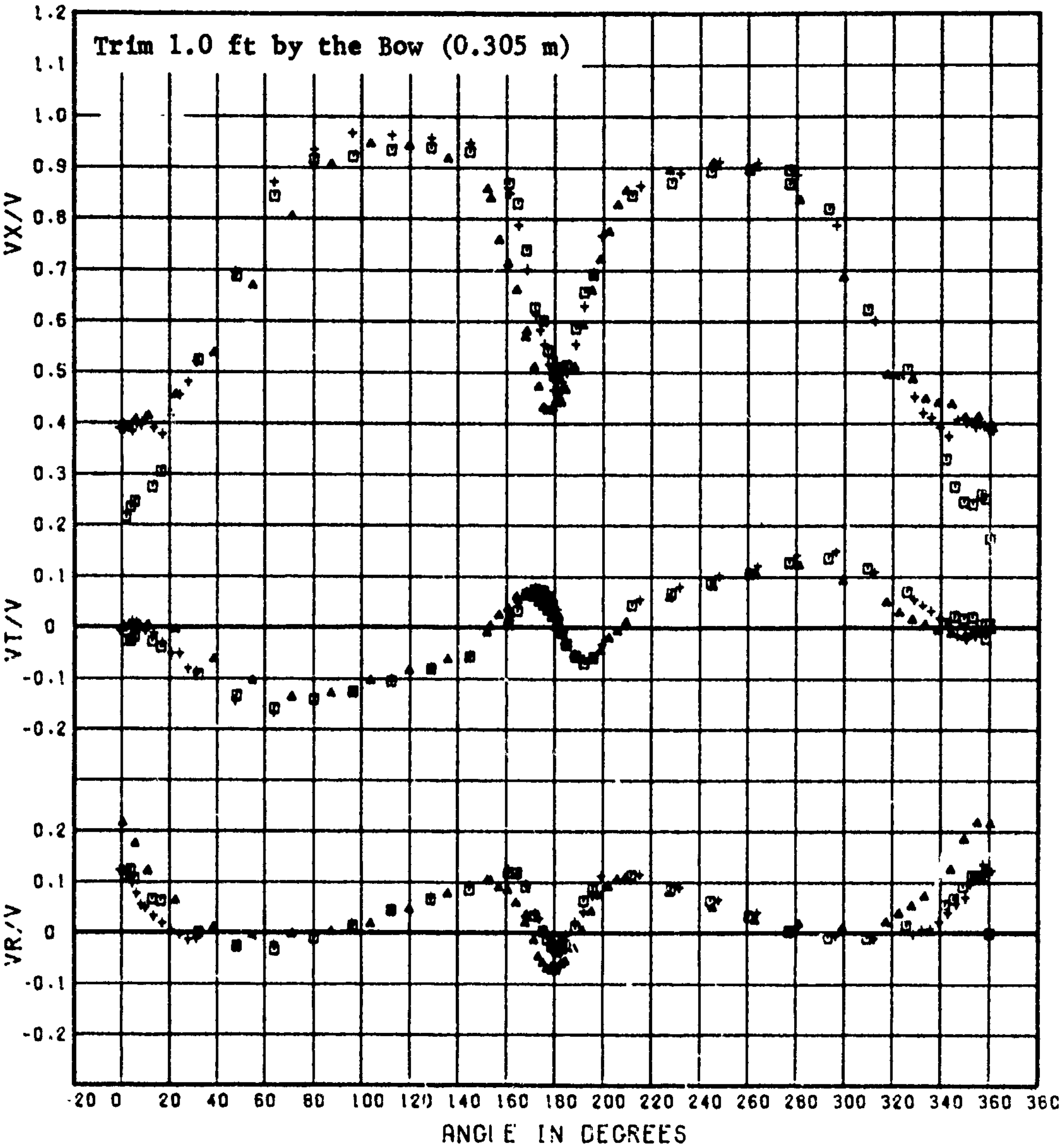
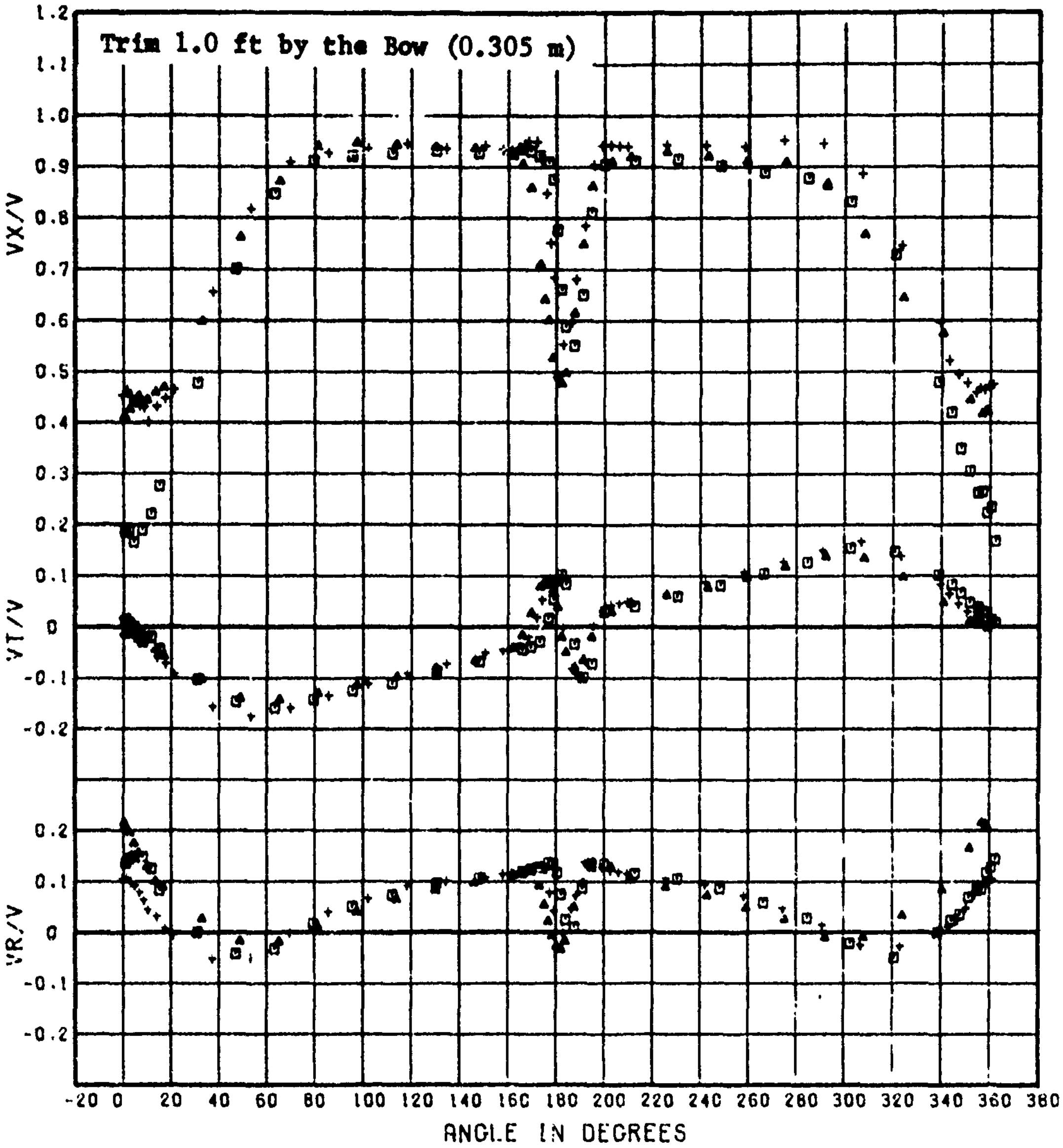


Figure 15 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 4 (SSPA) and also without Fins at a Radius Ratio of 0.359. Displacement 26,390 tons (26 810 metric tons)



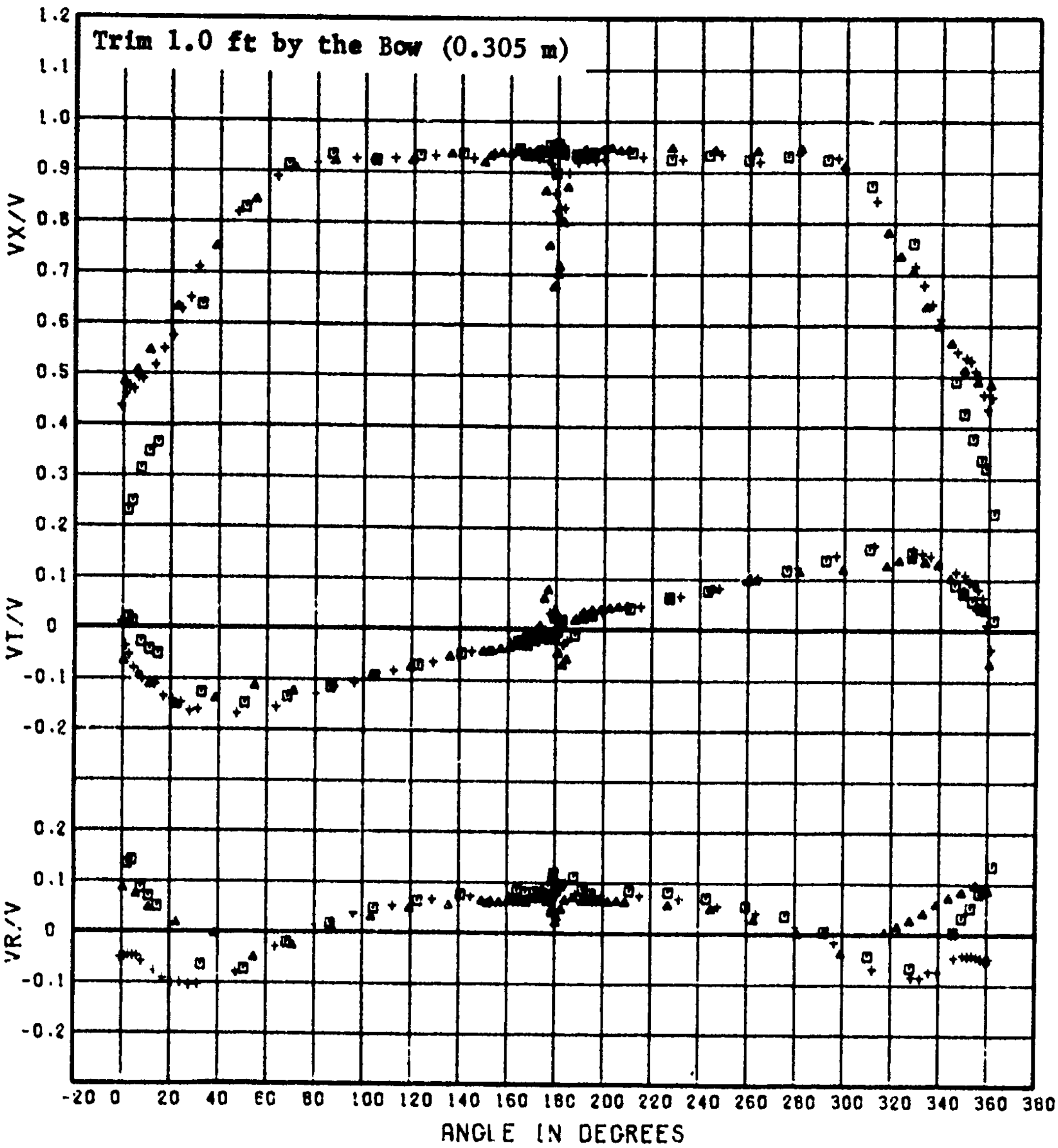
□ Experiment No. 1 without fins
▲ Experiment No. 2 Configuration 1 (NAVY)
\+ Experiment No. 7 Configuration 4 (SSPA)

Figure 16 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 4 (SSPA) and also without Fins at a Radius Ratio of 0.556. Displacement 26,390 tons (26 810 metric tons)



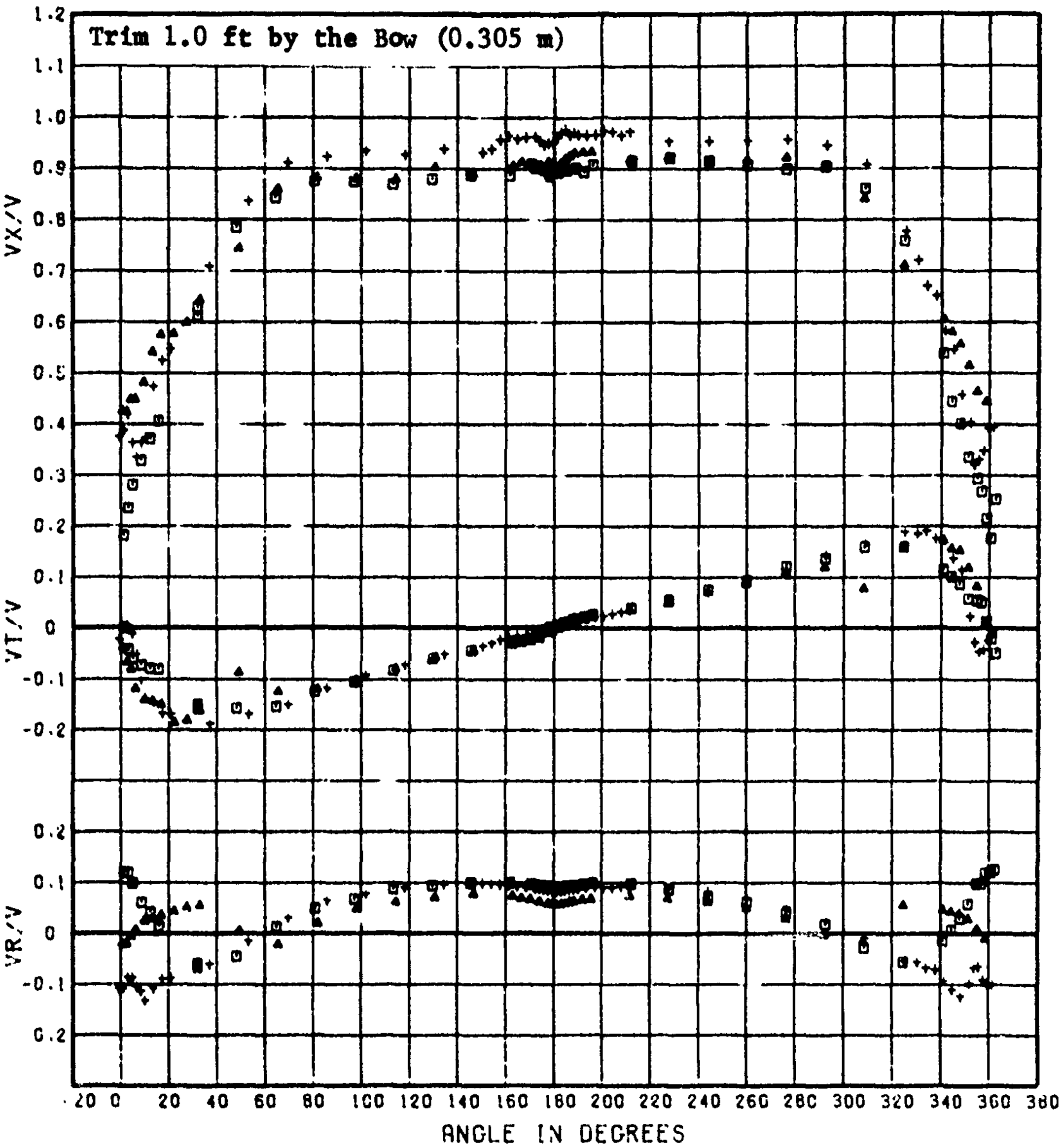
□ Experiment No. 1 without fins
▲ Experiment No. 2 Configuration 1 (NAVY)
+ Experiment No. 7 Configuration 4 (SSPA)

Figure 17 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 4 (SSPA) and also without Fins at a Radius Ratio of 0.775. Displacement 26,390 tons (26 810 metric tons)



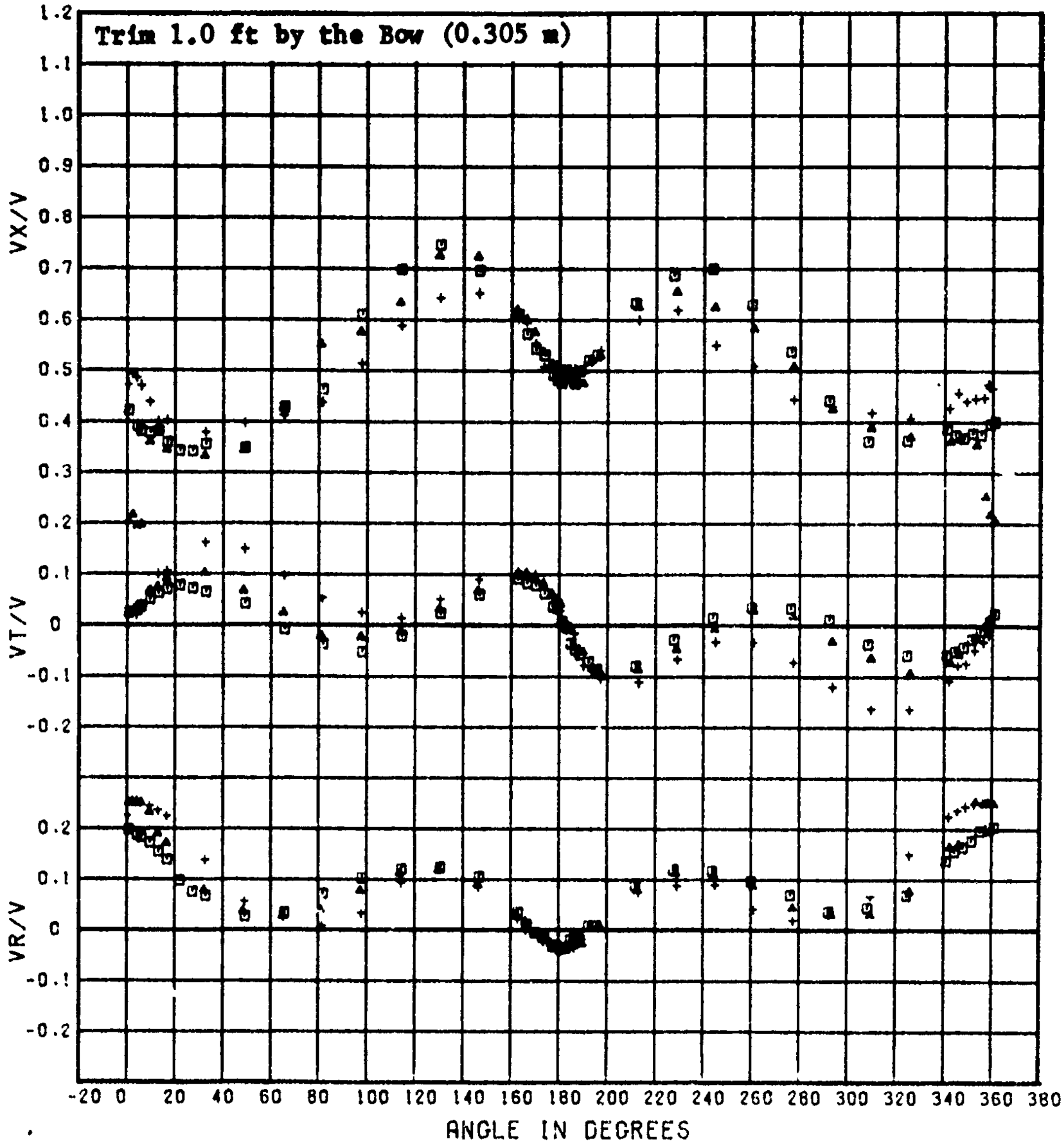
□ Experiment No. 1 without fins
▲ Experiment No. 2 Configuration 1 (NAVY)
+ Experiment No. 7 Configuration 4 (SSPA)

Figure 18 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 4 (SSPA) and also without Fins at a Radius Ratio of 1.017. Displacement 26,390 tons (26 810 metric tons)



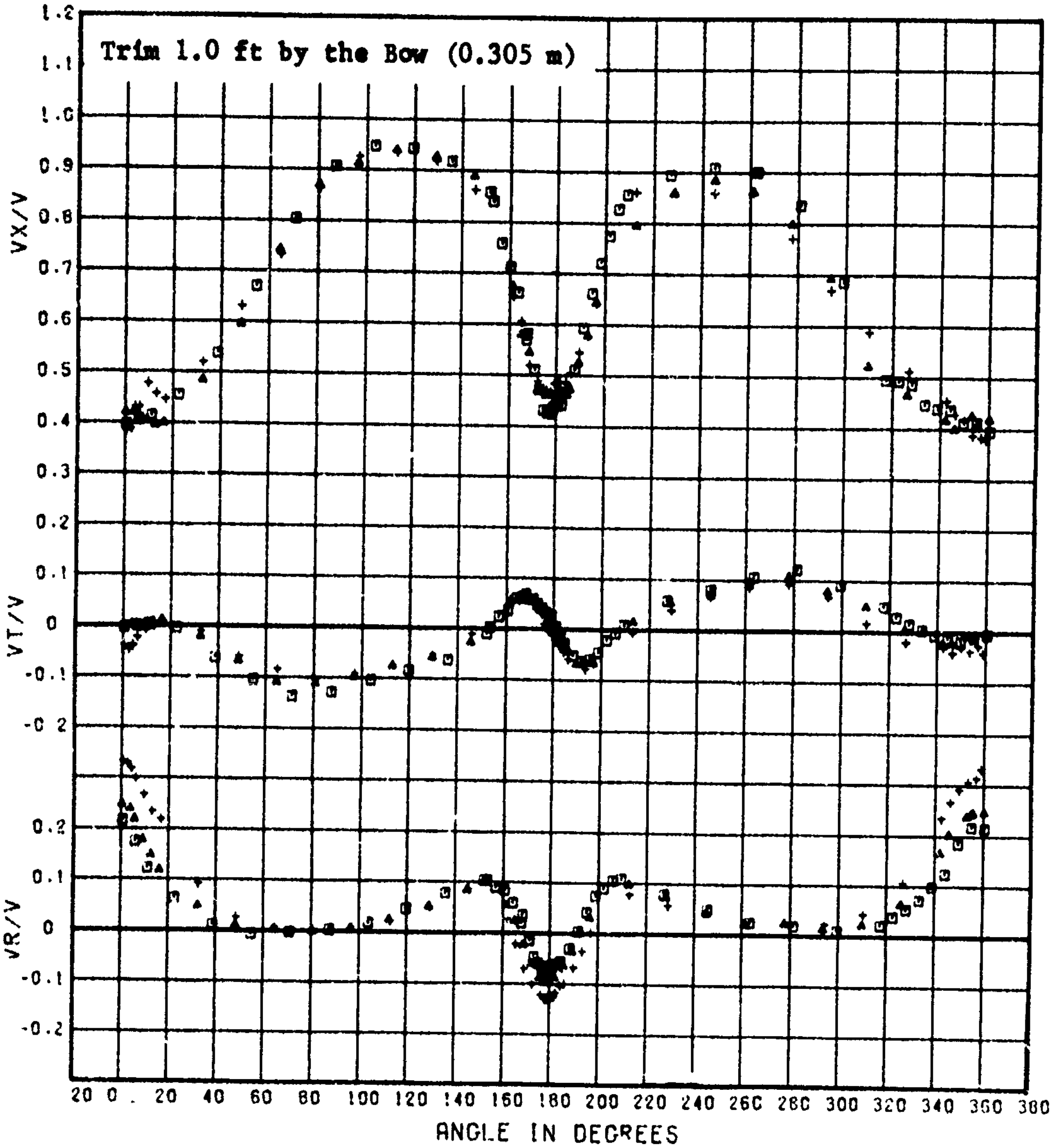
□ Experiment No. 1 without fins
▲ Experiment No. 2 Configuration 1 (NAVY)
\+ Experiment No. 7 Configuration 4 (SSPA)

Figure 19 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 4 (SSPA) and also without Fins at a Radius Ratio of 1.178. Displacement 26,390 tons (26 810 metric tons)



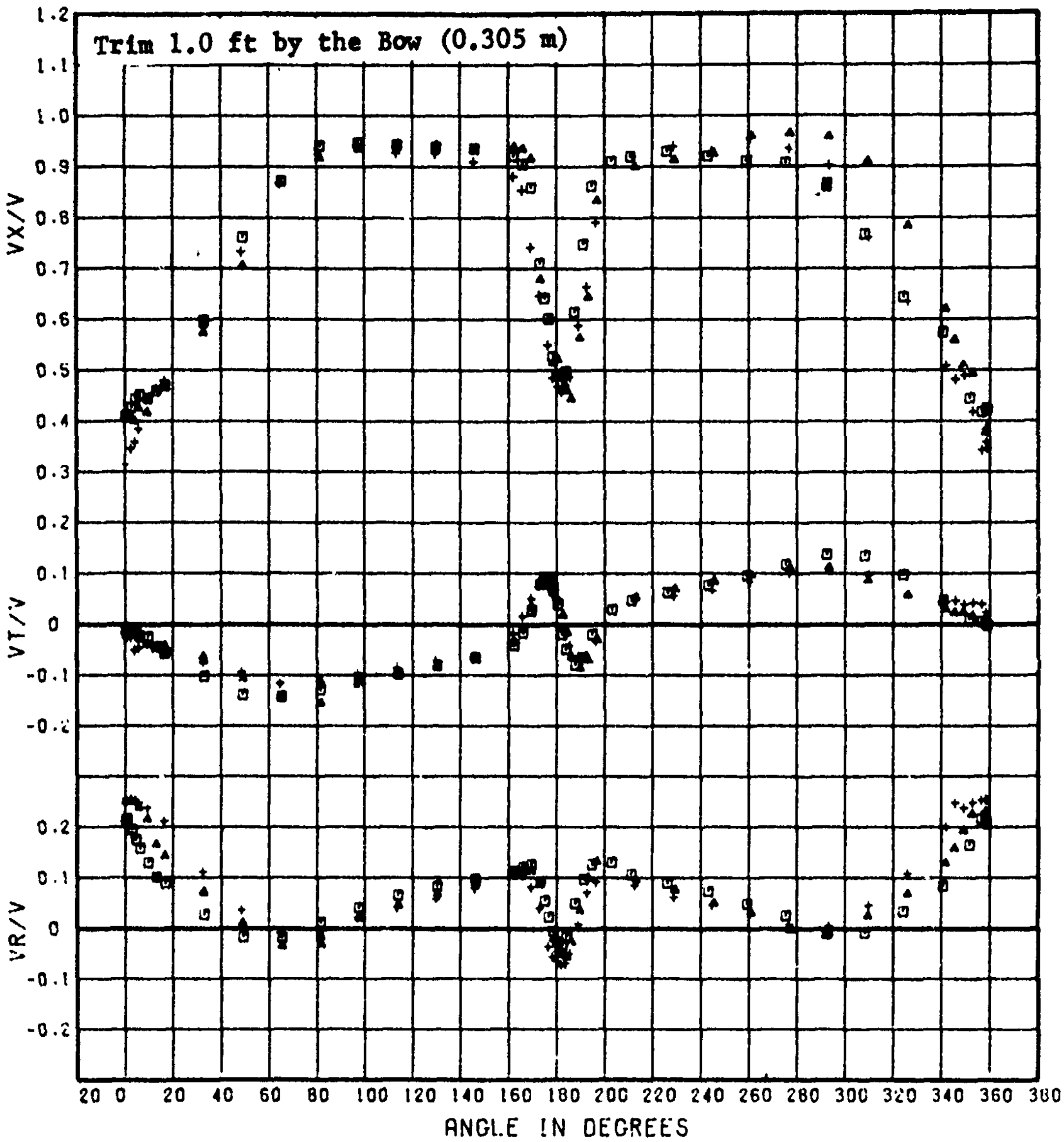
□ Experiment No. 2 Configuration 1 (NAVY)
▲ Experiment No. 4 Configuration 2 (NAVY)
+ Experiment No. 6 Configuration 3 (NAVY)

Figure 20 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 2 (NAVY) and Configuration 3 (NAVY) at a Radius Ratio of 0.359. Displacement 26,390 tons (26 810 metric tons)



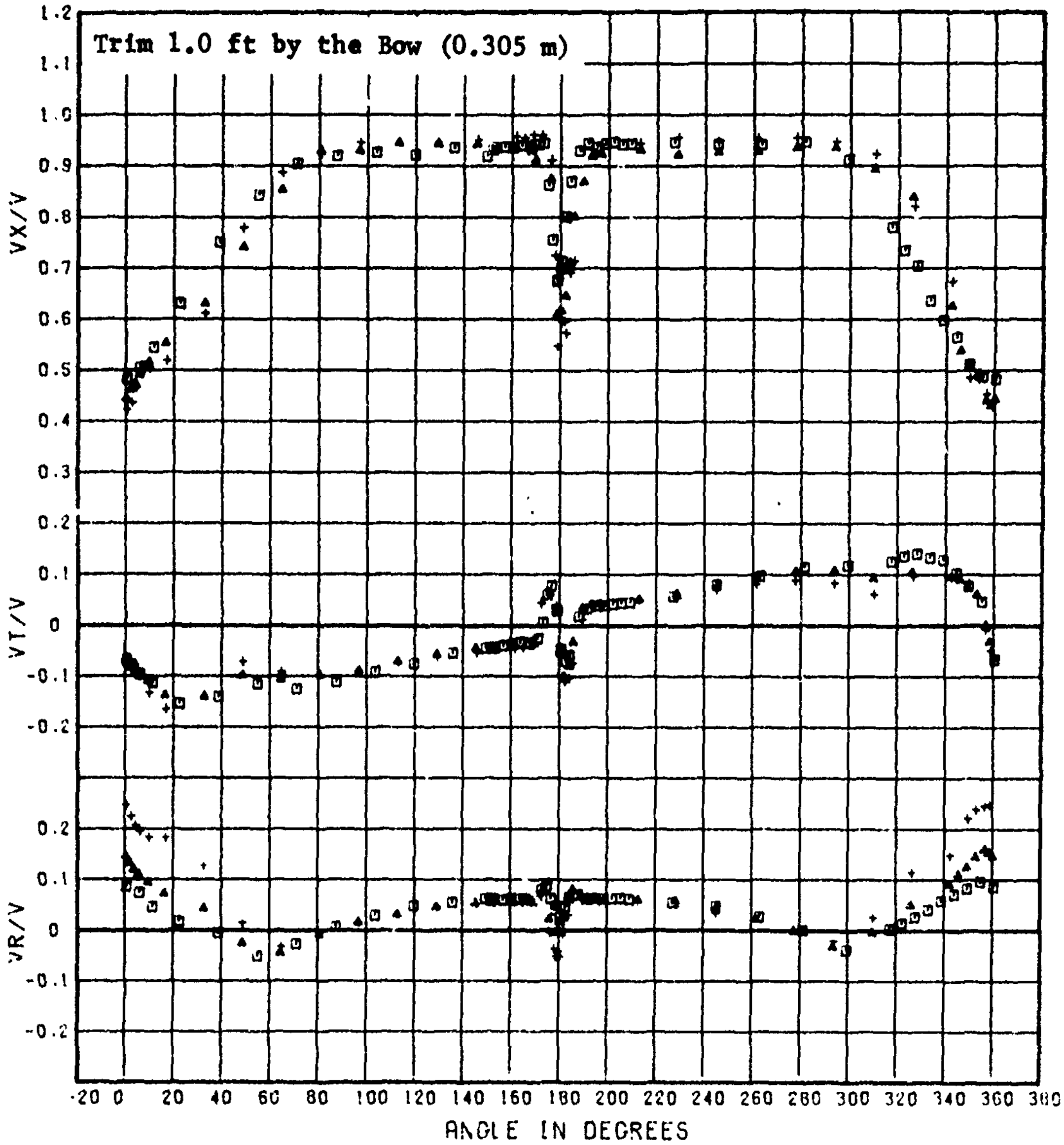
▫ Experiment No. 2 Configuration 1 (NAVY)
▴ Experiment No. 4 Configuration 2 (NAVY)
+ Experiment No. 6 Configuration 3 (NAVY)

Figure 21 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 2 (NAVY) and Configuration 3 (NAVY) at a Radius Ratio of 0.556. Displacement 26,390 tons (26 810 metric tons)



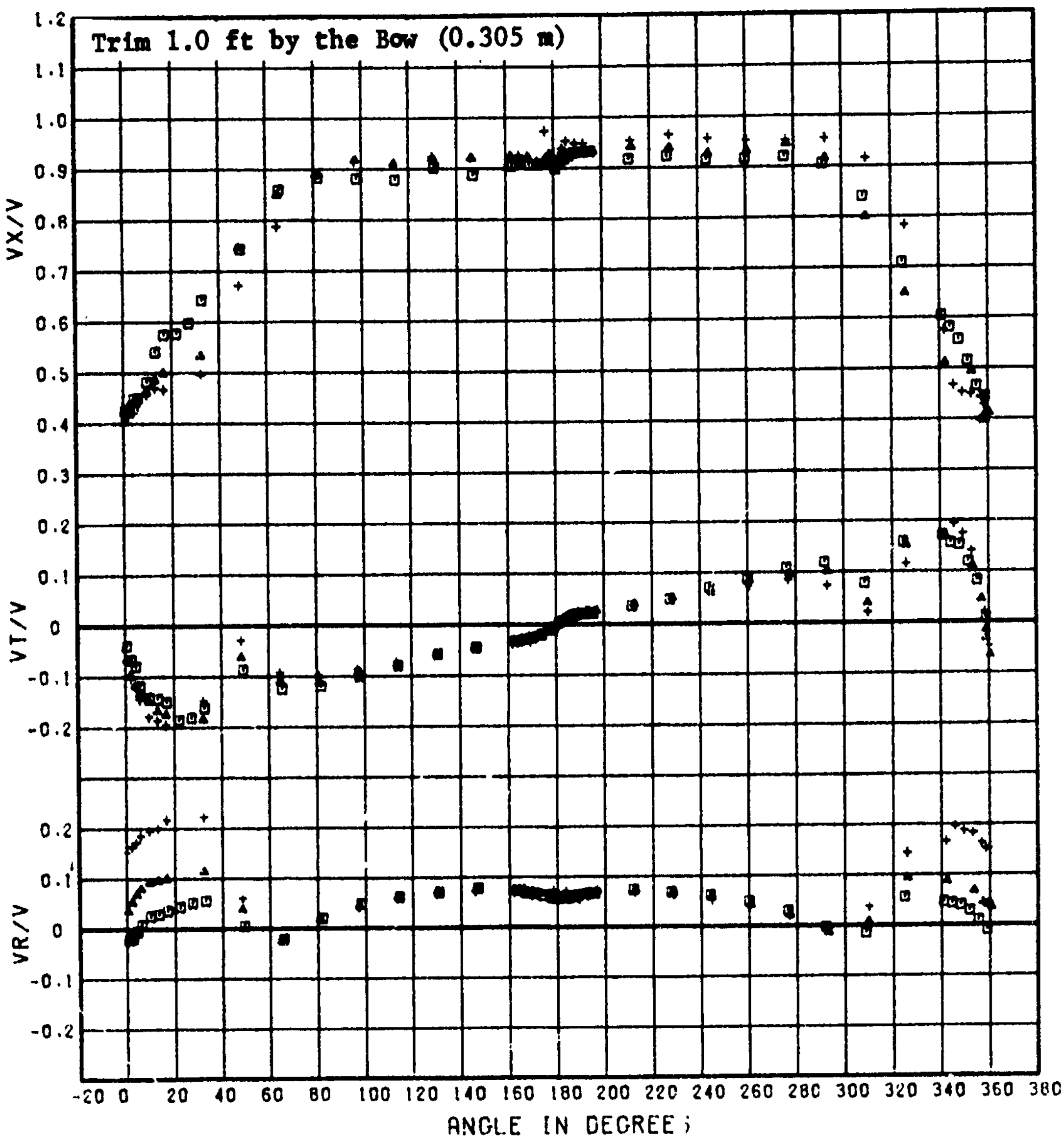
□ Experiment No. 2 Configuration 1 (NAVY)
▴ Experiment No. 4 Configuration 2 (NAVY)
+ Experiment No. 6 Configuration 3 (NAVY)

Figure 22 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 2 (NAVY) and Configuration 3 (NAVY) at a Radius Ratio of 0.775. Displacement 26,390 tons (26 810 metric tons)



□ Experiment No. 2 Configuration 1 (NAVY)
▴ Experiment No. 4 Configuration 2 (NAVY)
+ Experiment No. 6 Configuration 3 (NAVY)

Figure 23 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 2 (NAVY) and Configuration 3 (NAVY) at a Radius Ratio of 1.017. Displacement 26,390 tons (26 810 metric tons)



□ Experiment No. 2 Configuration 1 (NAVY)
▲ Experiment No. 4 Configuration 2 (NAVY)
\+ Experiment No. 6 Configuration 3 (NAVY)

Figure 24 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY), Configuration 2 (NAVY) and Configuration 3 (NAVY) at a Radius Ratio of 1.178 Displacement 26,390 tons (26 810 metric tons)

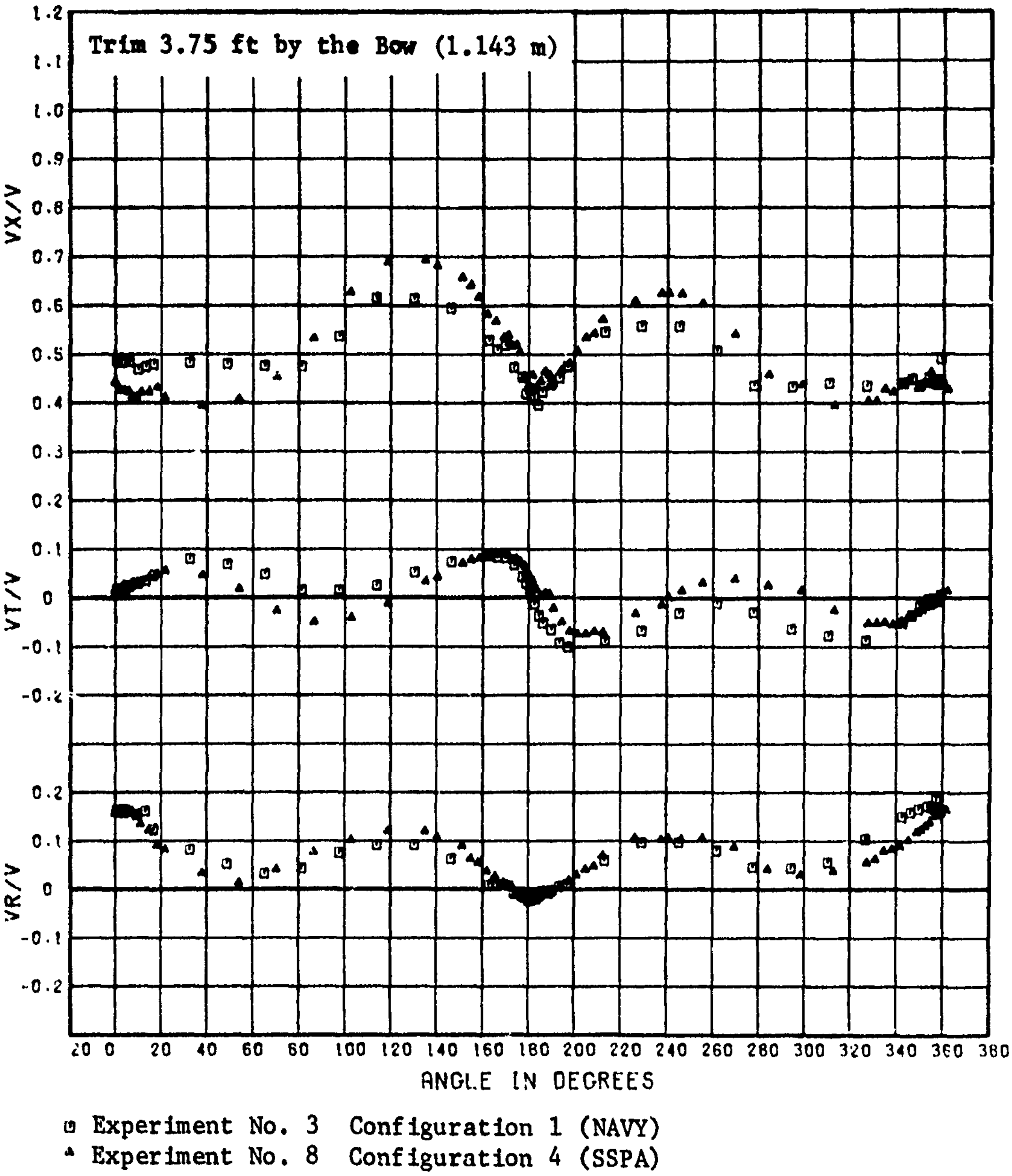
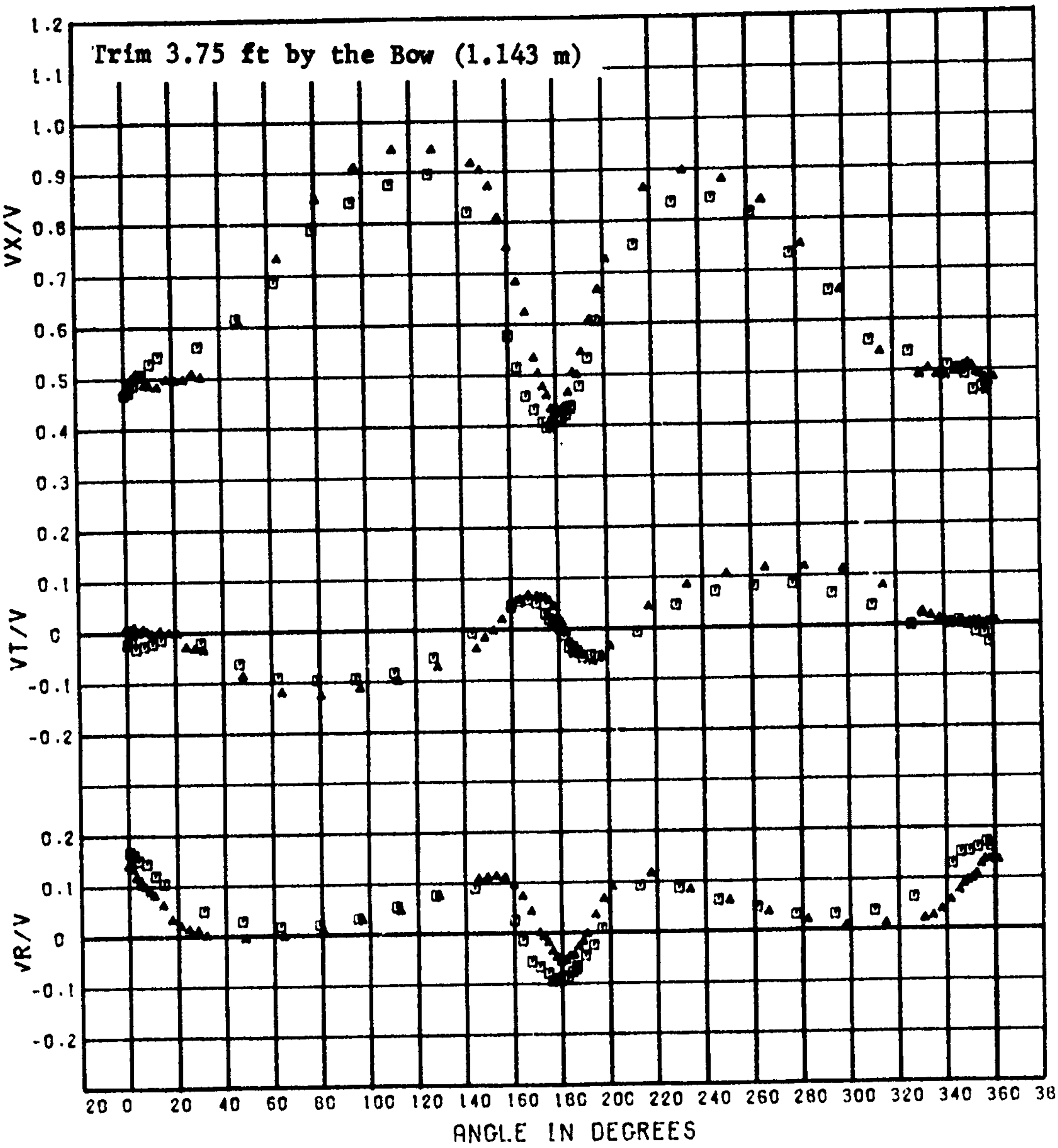


Figure 25 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY) and Configuration 4 (SSPA) at a Radius Ratio of 0.359. Displacement 17,270 tons (17 550 metric tons)



□ Experiment No. 3 Configuration 1 (NAVY)
▲ Experiment No. 8 Configuration 4 (SSPA)

Figure 26 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY) and Configuration 4 (SSPA) at a Radius Ratio of 0.556. Displacement 17,270 tons (17 550 metric tons)

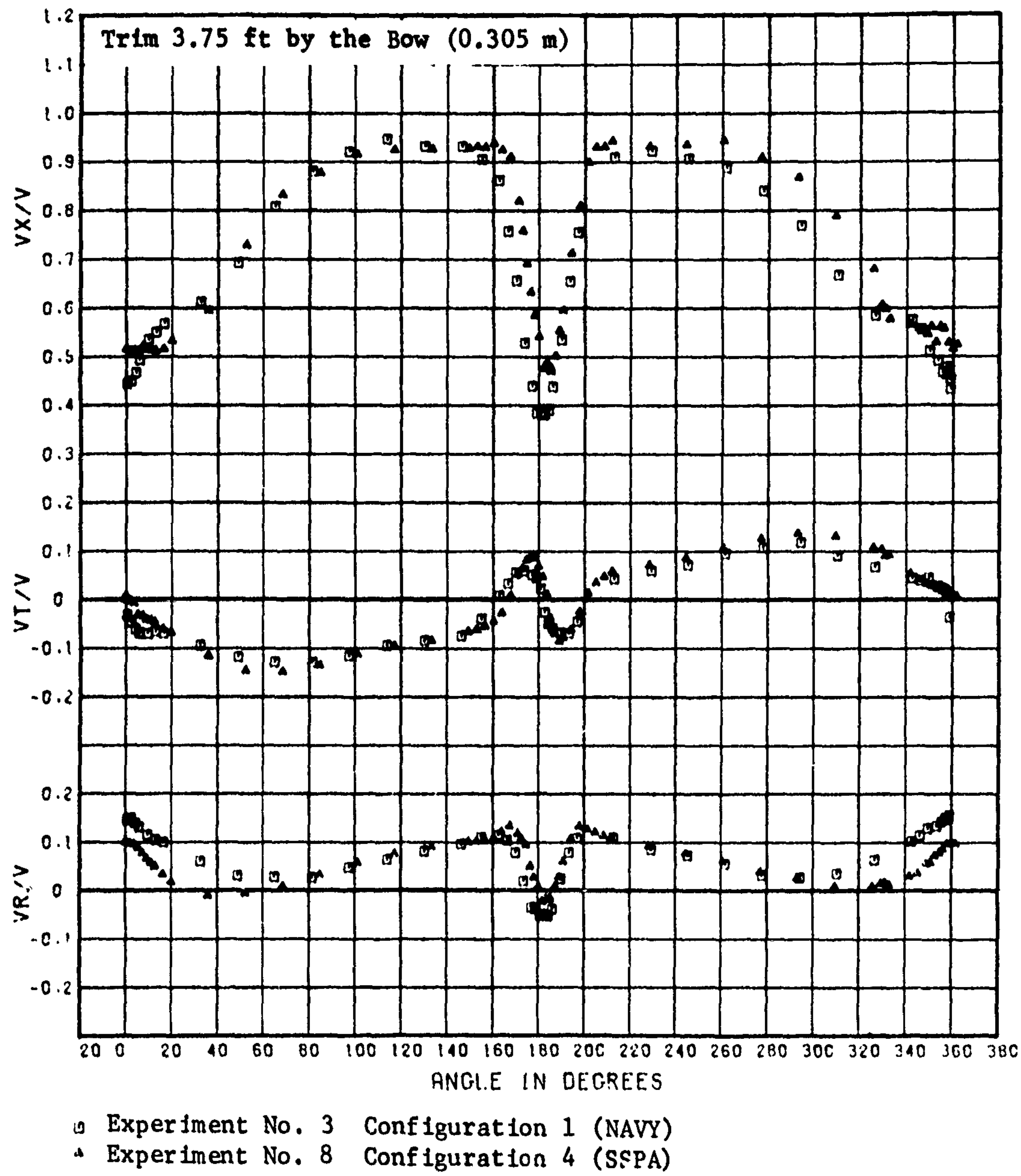


Figure 27 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY) and Configuration 4 (SSPA) at a Radius Ratio of 0.775. Displacement 17,270 tons (17 550 metric tons)

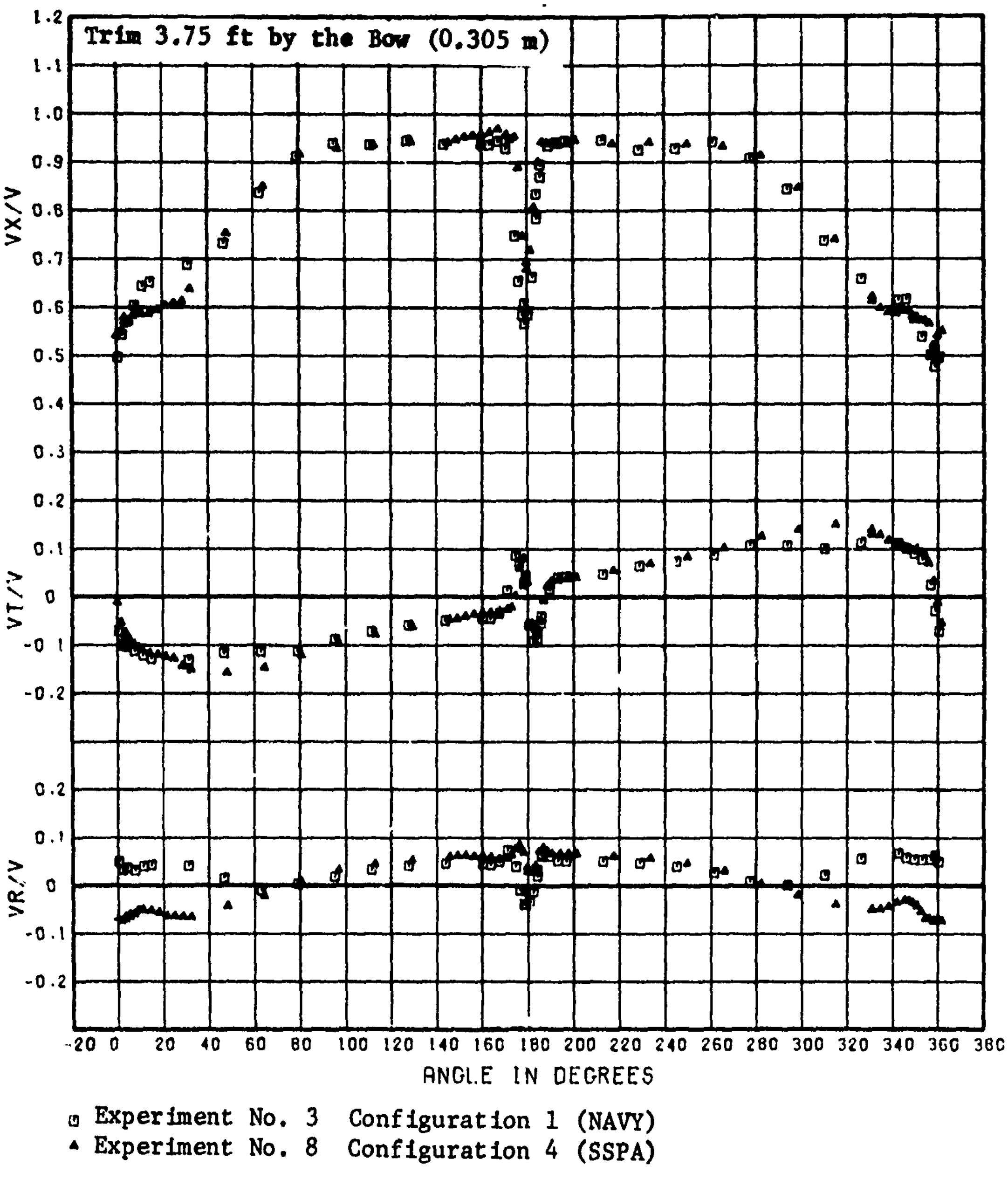


Figure 28 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 1 (NAVY) and Configuration 4 (SSPA) at a Radius Ratio of 1.017. Displacement 17,270 tons (17 550 metric tons)

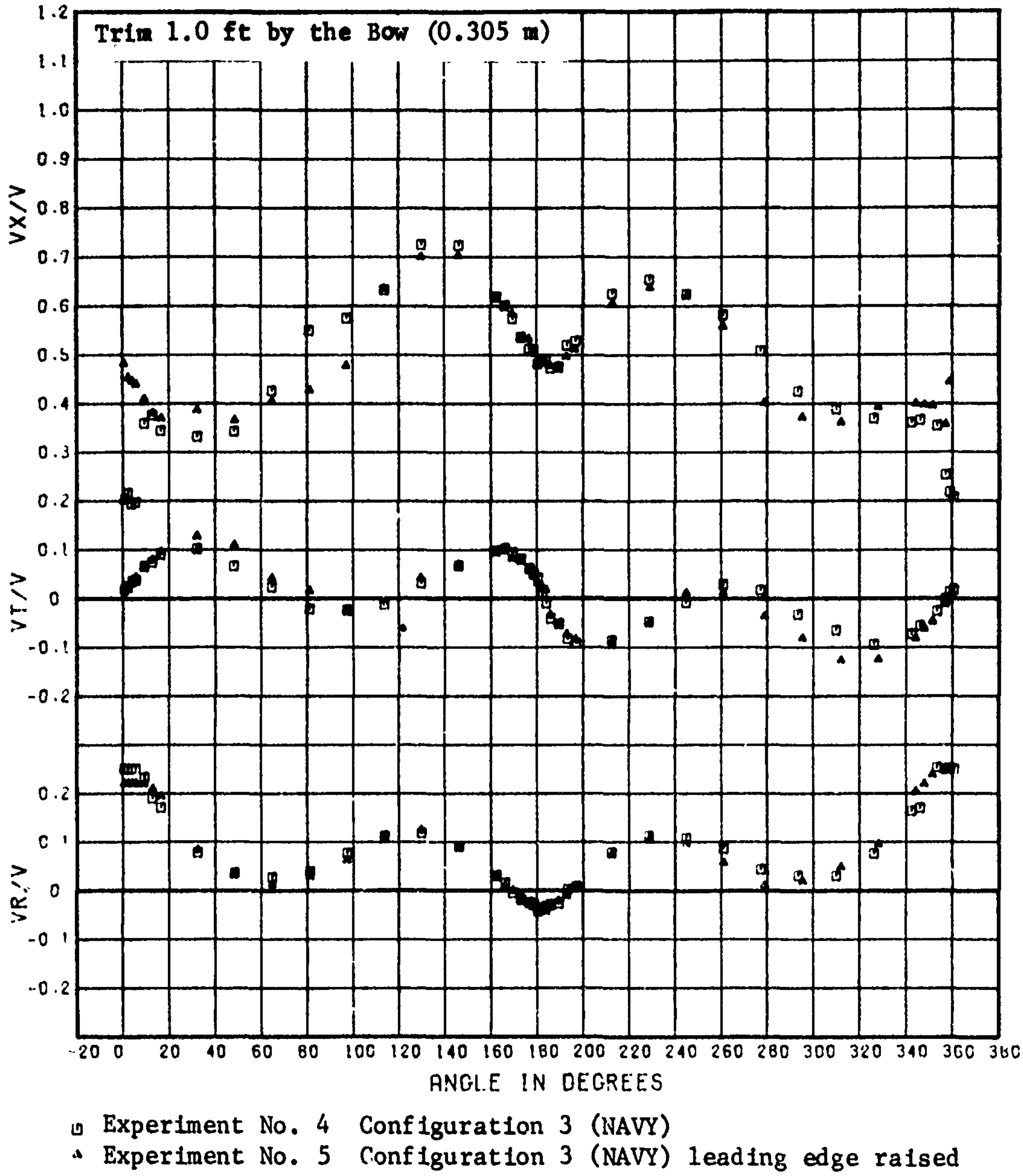


Figure 29 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees at a Radius Ratio of 0.359. Displacement 26,390 tons (26 810 metric tons)

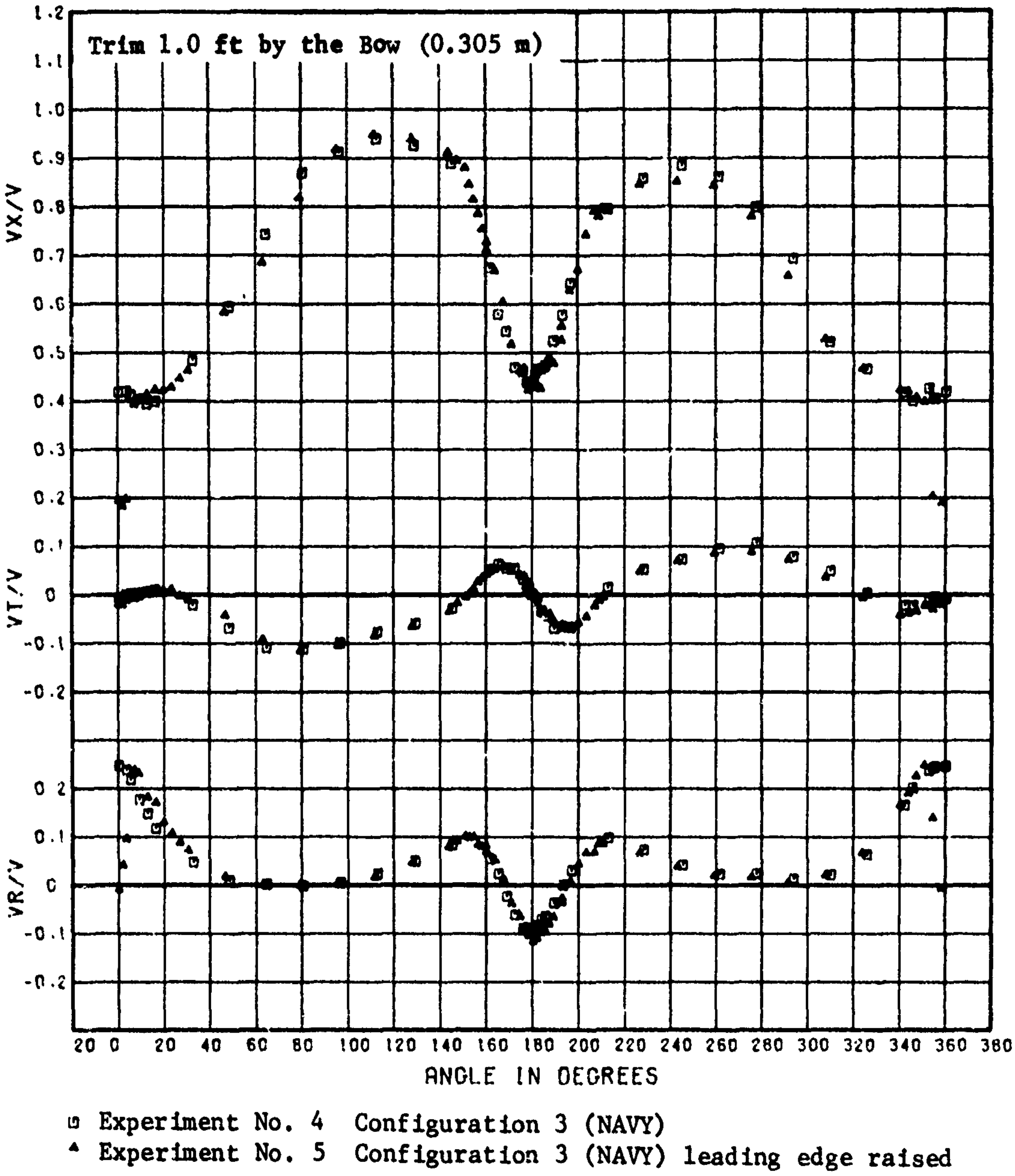
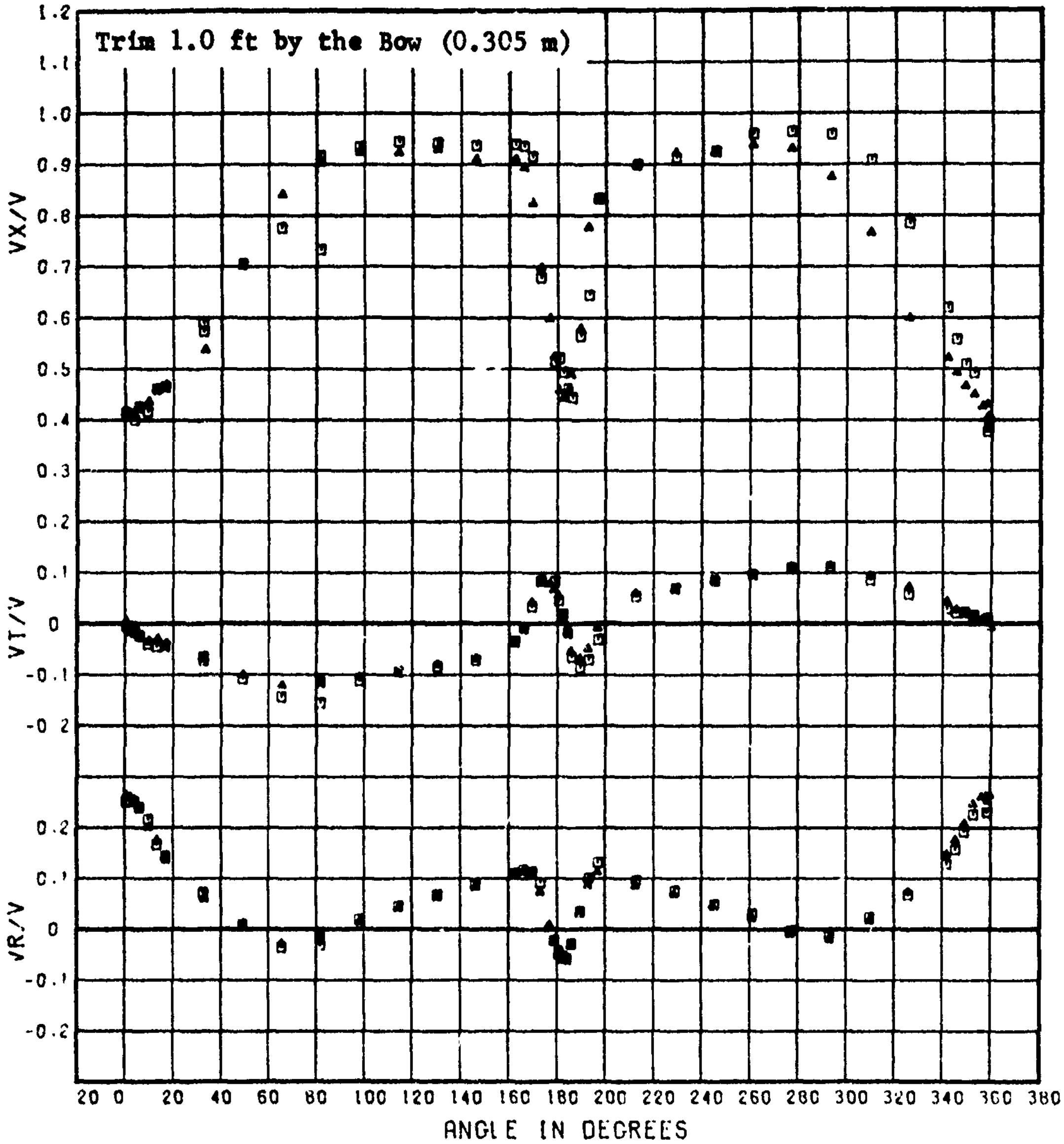
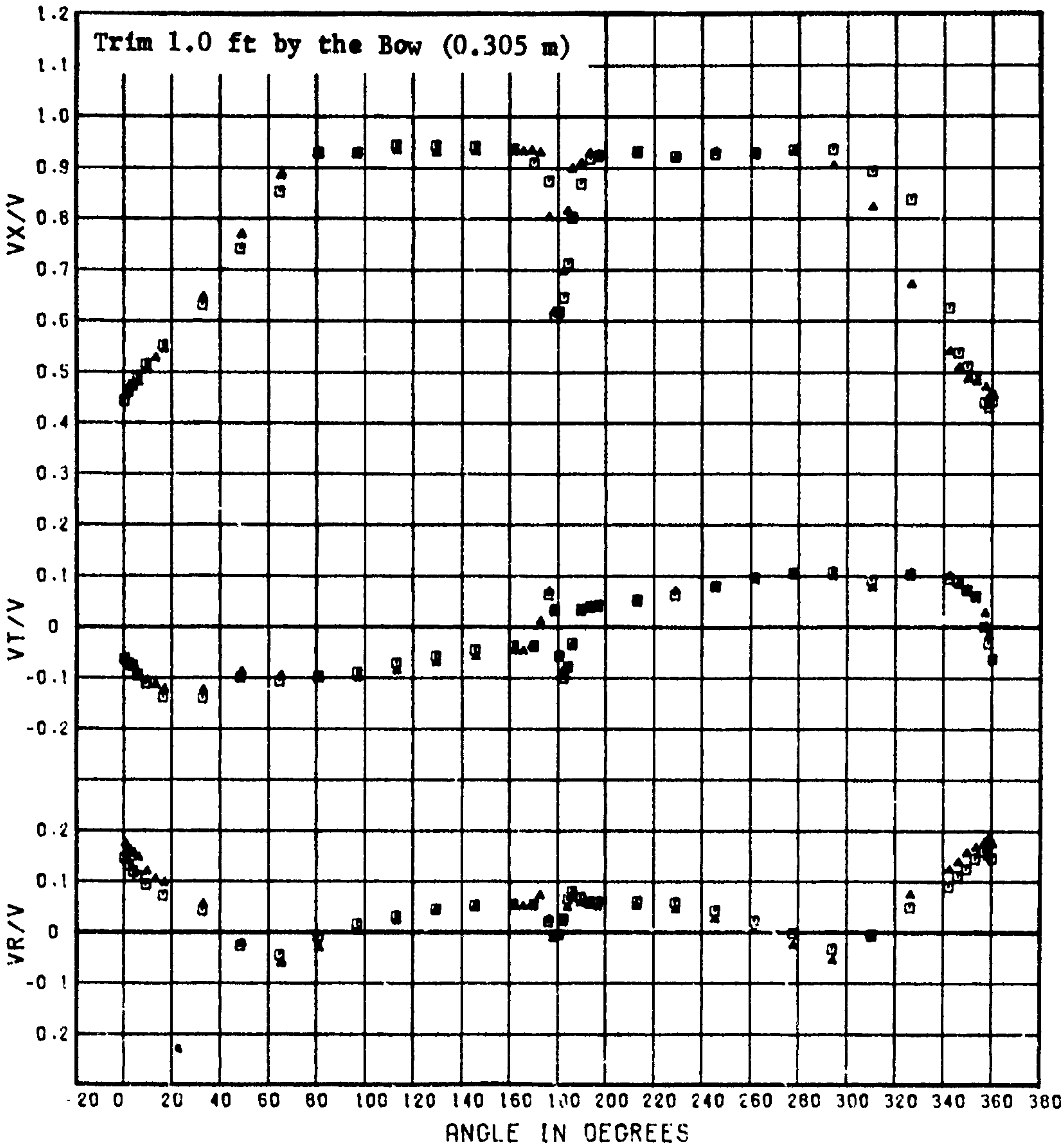


Figure 30 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees at a Radius Ratio of 0.556. Displacement 26,390 tons (26 810 metric tons)



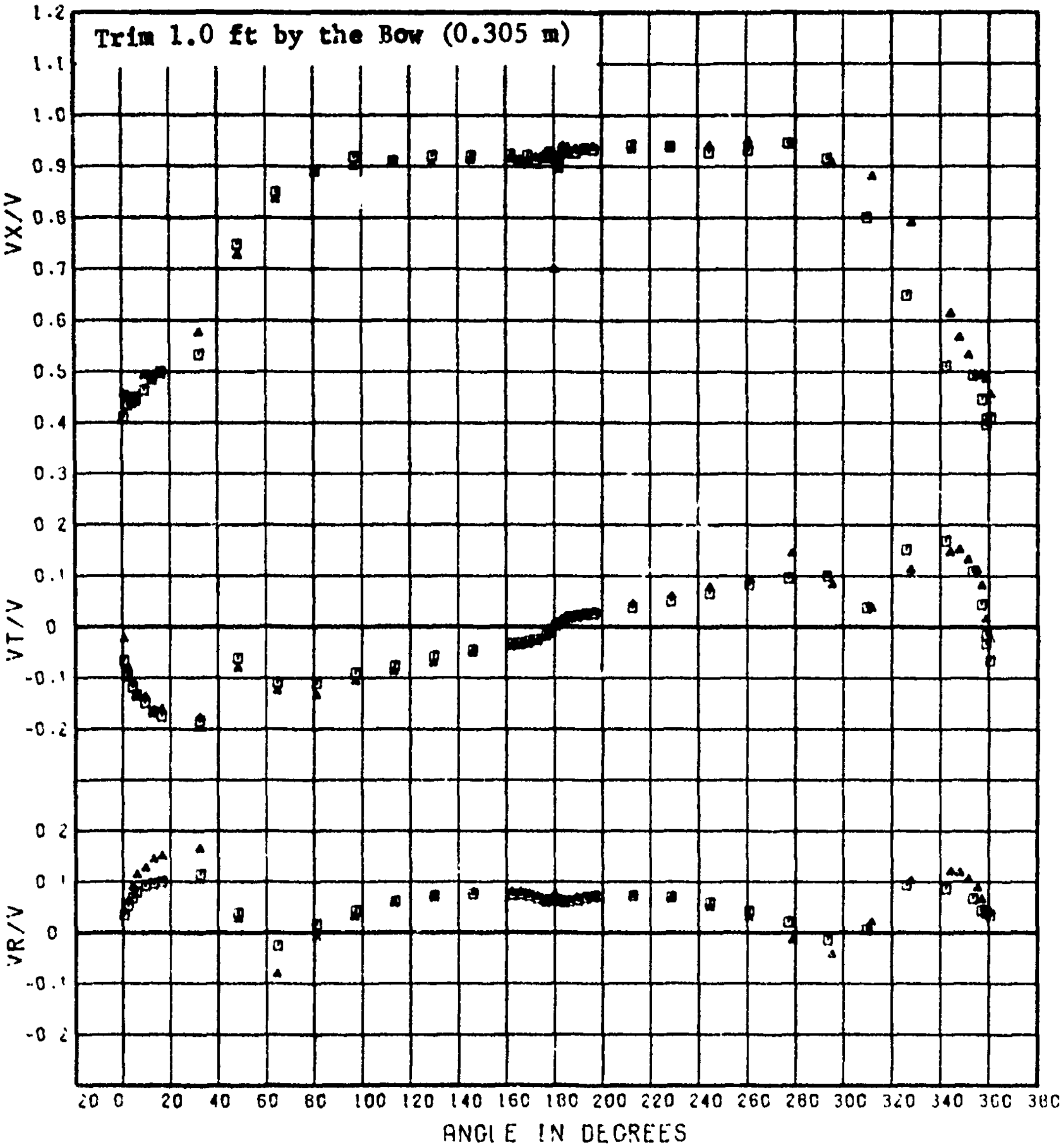
▫ Experiment No. 4 Configuration 3 (NAVY)
▴ Experiment No. 5 Configuration 3 (NAVY) leading edge raised

Figure 31 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees at a Radius Ratio of 0.775. Displacement 26,390 tons (26 810 metric tons)



□ Experiment No. 4 Configuration 3 (NAVY)
▲ Experiment No. 5 Configuration 3 (NAVY) leading edge raised

Figure 32 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees at a Radius Ratio of 1.017. Displacement 26,390 tons (26 810 metric tons)



▫ Experiment No. 4 Configuration 3 (NAVY)
▵ Experiment No. 5 Configuration 3 (NAVY) leading edge raised

Figure 33 - Composite Circumferential Distribution of the Longitudinal, Tangential and Radial Velocity Component Ratios for Fins Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees at a Radius Ratio of 1.178. Displacement 26,390 tons (26 810 metric tons)

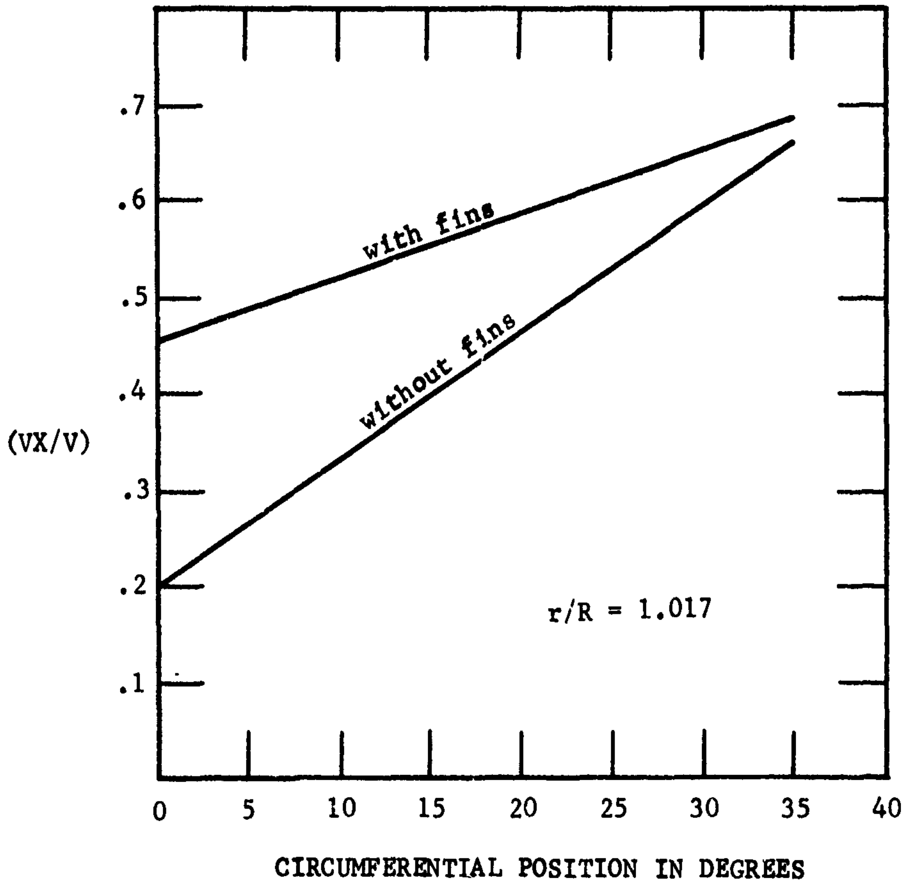


Figure 34 - Typical Improvement of the Longitudinal Velocity (VX/V) with the Addition of Fins

Table 1 - Comparison of the Circumferential Mean Velocity Component Ratios and other Derived Quantities for the without Fins Configuration and with Configuration 1 (NAVY), Configuration 2 (NAVY), Configuration 3 (NAVY), and Configuration 4 (SSPA), Trimmed 1.0 feet (0.305 m) by the Bow. Displacement 26,390 Tons (26 810 metric tons).

Experiment No.	Fin	RADIUS	VXBAR	VTBAR	VRBAR	1-WVX	1-WX	BBAR	BPOS	BNEG
1**	NONE	.200*	.360	-.005	.143	.000	.000	30.26	22.05	-38.71
2	1 (NAVY)		.280	.009	.137	.000	.000	23.88	23.24	-32.61
6	2 (NAVY)		.246	.007	.118	.000	.000	21.34	27.61	-32.05
4	3 (NAVY)		.293	.007	.129	.000	.000	24.92	24.67	-39.26
7	4 (SSPA)		.369	.000	.135	.000	.000	30.68	20.40	-28.80
1	NONE	.300*	.498	-.006	.098	.443	.456	28.27	13.72	-18.38
2	1 (NAVY)		.439	.003	.099	.375	.380	25.12	9.29	-11.97
6	2 (NAVY)		.412	-.001	.094	.346	.376	23.86	9.06	-11.21
4	3 (NAVY)		.431	.003	.095	.375	.389	24.70	10.31	-20.69
7	4 (SSPA)		.508	-.002	.095	.452	.458	28.59	11.08	-15.03
1	NONE	.359	.567	-.007	.078	.493	.504	27.05	11.60	-16.94
2	1 (NAVY)		.519	.001	.081	.434	.438	24.93	8.38	-9.03
6	2 (NAVY)		.496	-.004	.083	.407	.431	24.04	7.02	-7.53
4	3 (NAVY)		.502	.001	.079	.427	.439	24.20	8.15	-15.07
7	4 (SSPA)		.578	-.003	.077	.503	.509	27.40	10.18	-12.38
1	NONE	.400*	.608	-.008	.066	.507	.516	26.17	10.40	-17.14
2	1 (NAVY)		.569	-.001	.071	.450	.452	24.60	8.32	-8.72
6	2 (NAVY)		.548	-.006	.077	.424	.439	23.88	6.32	-7.04
4	3 (NAVY)		.548	.000	.070	.441	.447	23.78	8.22	-12.49
7	4 (SSPA)		.621	-.003	.066	.517	.521	26.58	9.58	-12.09
1	NONE	.500*	.690	-.008	.045	.570	.577	24.03	8.13	-16.97
2	1 (NAVY)		.670	-.008	.054	.524	.527	23.36	8.04	-9.08
6	2 (NAVY)		.654	-.009	.066	.501	.512	22.91	7.20	-8.24
4	3 (NAVY)		.644	-.004	.055	.509	.513	22.56	8.00	-9.19
7	4 (SSPA)		.710	-.004	.047	.582	.586	24.58	8.38	-11.76
1	NONE	.556	.723	-.008	.039	.599	.606	22.79	7.26	-16.58
2	1 (NAVY)		.713	-.006	.048	.560	.562	22.48	7.74	-9.61
6	2 (NAVY)		.699	-.010	.063	.539	.548	22.13	7.47	-9.43
4	3 (NAVY)		.690	-.005	.050	.543	.547	21.79	7.79	-8.98
7	4 (SSPA)		.748	-.004	.041	.613	.618	23.44	7.67	-11.20
1	NONE	.600*	.732	-.007	.045	.619	.626	21.49	6.52	-16.12
2	1 (NAVY)		.733	-.006	.054	.586	.589	21.49	6.81	-9.61
6	2 (NAVY)		.719	-.008	.066	.566	.574	21.14	6.58	-9.89
4	3 (NAVY)		.719	-.006	.055	.569	.573	21.12	6.70	-9.46
7	4 (SSPA)		.768	-.004	.046	.637	.641	22.40	6.43	-10.39

Table 1 - Continued

Comparison of the Circumferential Mean Velocity Component Ratios and other Derived Quantities for the without Fins Configuration and with Configuration 1 (NAVY), Configuration 2 (NAVY), Configuration 3 (NAVY), and Configuration 4 (SSPA), Trimmed 1.0 feet (0.305 m) by the Bow. Displacement 26,390 Tons (26 810 metric tons).

1	NONE	.700*	.753	-.006	.052	.655	.662	19.12	5.12	-14.89
2	1 (NAVY)		.771	-.007	.060	.635	.638	19.55	5.12	-9.22
6	2 (NAVY)		.759	-.006	.070	.617	.623	19.26	5.02	-10.66
4	3 (NAVY)		.773	-.008	.061	.621	.625	19.61	4.82	-9.92
7	4 (SSPA)		.804	-.003	.051	.680	.685	20.30	4.33	-9.88
1	NONE	.775	.769	-.004	.053	.679	.685	17.73	4.27	-13.87
2	1 (NAVY)		.795	-.007	.059	.665	.669	18.29	4.19	-8.68
6	2 (NAVY)		.785	-.006	.070	.649	.655	18.08	4.10	-10.58
4	3 (NAVY)		.803	-.009	.061	.653	.656	18.49	3.81	-9.69
7	4 (SSPA)		.824	-.003	.050	.707	.711	18.89	3.31	-9.25
1	NONE	.800*	.782	-.002	.048	.683	.689	17.46	4.00	-13.34
2	1 (NAVY)		.804	-.006	.054	.673	.676	17.95	3.82	-8.25
6	2 (NAVY)		.798	-.006	.067	.657	.663	17.81	3.76	-10.05
4	3 (NAVY)		.811	-.008	.055	.664	.668	18.10	3.52	-9.33
7	4 (SSPA)		.827	-.002	.042	.715	.718	18.40	3.09	-8.46
1	NONE	.900*	.817	.003	.035	.709	.714	16.25	3.12	-11.77
2	1 (NAVY)		.832	-.005	.037	.705	.708	16.58	2.67	-7.13
6	2 (NAVY)		.834	-.009	.057	.692	.697	16.64	2.73	-8.40
4	3 (NAVY)		.832	-.005	.039	.699	.702	16.58	2.70	-8.09
7	4 (SSPA)		.837	-.001	.019	.741	.744	16.65	2.41	-7.14
1	NONE	1.017	.830	.005	.031	.732	.736	14.67	2.37	-10.49
2	1 (NAVY)		.843	-.004	.030	.734	.737	14.93	1.85	-6.28
6	2 (NAVY)		.851	-.009	.057	.724	.729	15.09	2.01	-7.20
4	3 (NAVY)		.839	-.004	.035	.729	.731	14.87	2.11	-7.01
7	4 (SSPA)		.845	.000	.010	.764	.767	14.96	1.90	-6.89
1	NONE	1.178	.797	.001	.045	.754	.757	12.27	1.68	-10.13
2	1 (NAVY)		.819	-.003	.041	.760	.762	12.61	1.59	-5.88
6	2 (NAVY)		.827	-.007	.077	.755	.759	12.75	2.35	-6.54
4	3 (NAVY)		.816	-.006	.054	.755	.757	12.58	1.83	-6.36
7	4 (SSPA)		.850	-.002	.030	.786	.788	13.06	1.78	-8.01

* INTERPOLATED

**EXPERIMENT 1 REPEAT (October 1980)

Table 2 - Comparison of the Circumferential Mean Velocity Component Ratios and other Derived Quantities for Fins Configuration 3 (NAVY), and Configuration 4 (SSPA), Trimmed 3.75 feet (1.143 m) by the Stern. Displacement 17,270 Tons (17 550 metric tons).

Experiment No.	Fin	RADIUS	VXBAR	VTBAR	VRBAR	1-WVX	1-WX	BBAR	BPOS	BNEG
3	1 (NAVY)	.200*	.291	.001	.109	.000	.000	25.05	21.04	-21.95
8	4 (SSPA)		.270	.001	.116	.000	.000	23.40	20.56	-23.74
3	1 (NAVY)	.300*	.430	-.001	.083	.374	.381	24.75	5.31	-6.33
8	4 (SSPA)		.432	.002	.085	.367	.371	24.82	5.48	-7.95
3	1 (NAVY)	.359	.500	-.003	.071	.425	.431	24.18	4.19	-3.75
8	4 (SSPA)		.514	.001	.070	.427	.430	24.69	7.21	-6.30
3	1 (NAVY)	.400*	.544	-.004	.064	.440	.443	23.69	5.39	-5.12
8	4 (SSPA)		.565	.001	.062	.444	.445	24.39	7.86	-6.35
3	1 (NAVY)	.500*	.635	-.006	.054	.505	.508	22.29	6.79	-7.85
8	4 (SSPA)		.667	.000	.048	.519	.520	23.21	8.15	-8.24
3	1 (NAVY)	.556	.675	-.007	.052	.537	.540	21.41	6.88	-8.54
8	4 (SSPA)		.711	.000	.044	.555	.557	22.36	7.73	-8.56
3	1 (NAVY)	.600*	.695	-.009	.058	.561	.564	20.51	6.38	-8.81
8	4 (SSPA)		.731	-.002	.049	.582	.584	21.42	6.56	-8.72
3	1 (NAVY)	.700*	.735	-.011	.065	.606	.610	18.75	5.35	-9.28
8	4 (SSPA)		.771	-.004	.055	.632	.634	19.52	4.56	-8.29
3	1 (NAVY)	.775	.762	-.012	.066	.636	.640	17.62	4.60	-8.76
8	4 (SSPA)		.794	-.004	.053	.663	.665	18.26	3.54	-7.20
3	1 (NAVY)	.800*	.770	-.011	.065	.643	.647	17.28	4.35	-8.50
8	4 (SSPA)		.800	-.004	.044	.670	.672	17.85	3.32	-6.39
3	1 (NAVY)	.900*	.801	-.009	.055	.675	.679	16.01	3.35	-7.00
8	4 (SSPA)		.820	-.002	.020	.701	.703	16.34	2.70	-5.39
3	1 (NAVY)	1.017	.830	-.003	.033	.707	.711	14.71	2.28	-5.94
8	4 (SSPA)		.835	-.001	.011	.730	.732	14.79	2.40	
3	1 (NAVY)	1.178	PITOT TUBE OUT OF WATER							
8	4 (SSPA		.839	-.003	.030	.759	.760	12.91	1.95	-7.13

* INTERPOLATED

Table 3 - Comparison of the Circumferential Mean Velocity Component Ratios and other Derived Quantities for Fin Configuration 3 (NAVY) and Configuration 3 (NAVY) Leading Edge Raised 2.5 Degrees. Trimmed 1.0 feet (0.305 m) by the Bow. Displacement 26,390 Tons (26 810 metric tons).

Experiment No.	Fin Angle (Degrees)	RADIUS	VXBAR	VTBAR	VRBAR	1-WVX	1-WX	BBAR	BPOS	BNEG
4	0	.200*	.293	.007	.129	.000	.000	24.92	24.67	-39.26
5	2.5		.289	.014	.129	.000	.000	24.41	32.20	-39.88
4	0	.300*	.431	.003	.095	.375	.389	24.70	10.31	-20.69
5	2.5		.424	.003	.093	.370	.382	24.36	10.62	-10.99
4	0	.359	.502	.001	.079	.427	.439	24.20	8.15	-15.07
5	2.5		.494	-.002	.076	.420	.430	23.89	7.35	-7.30
4	0	.400*	.548	.000	.070	.441	.447	23.78	8.22	-12.49
5	2.5		.538	-.004	.067	.434	.440	23.46	8.03	-10.62
4	0	.500*	.644	-.004	.055	.509	.513	22.56	8.00	-9.19
5	2.5		.631	-.009	.050	.500	.504	22.19	8.76	-15.67
4	0	.556	.690	-.005	.050	.543	.547	21.79	7.79	-8.98
5	2.5		.674	-.010	.046	.533	.537	21.39	8.57	-16.11
4	0	.600*	.719	-.006	.055	.569	.573	21.12	6.70	-9.46
5	2.5		.699	-.008	.051	.558	.562	20.62	7.27	-13.58
4	0	.700*	.773	-.008	.061	.621	.625	19.61	4.82	-9.92
5	2.5		.749	-.004	.058	.606	.610	19.01	5.05	-9.92
4	0	.775	.803	-.009	.061	.653	.656	18.49	3.81	-9.69
5	2.5		.778	-.003	.058	.637	.641	17.90	3.93	-8.29
4	0	.800*	.811	-.008	.055	.664	.668	18.10	3.52	-9.33
5	2.5		.785	-.002	.052	.647	.650	17.52	3.73	-7.89
4	0	.900*	.832	-.005	.039	.699	.702	16.58	2.70	-8.09
5	2.5		.808	-.003	.036	.680	.683	16.12	2.99	-7.21
4	0	1.017	.839	-.004	.035	.729	.731	14.87	2.11	-7.01
5	2.5		.825	0.004	.032	.711	.714	14.64	2.27	-6.58
4	0	1.178	.816	-.006	.054	.755	.757	12.58	1.83	-6.36
5	2.5		.830	-.010	.054	.742	.744	12.80	1.67	-5.81

*INTERPOLATED

TABLE 4 - EXPERIMFNTAL CONFIGURATIONS AND CORRESPONDING SHIP VALUES

Experiment No.	Fin Configuration	Displacement tons	Displacement metric tons	Trim feet	Trim meters
1 Repeat	none	26,390	26 810	1' x bow	0.305
2	1 (NAVY)	26,390	26 810	1' x bow	0.305
3	1 (NAVY)	17,270	17 550	3.75' x stern	1.143
4	3 (NAVY)	26,390	26 810	1' x bow	0.305
5	3 (NAVY)*	26,390	26 810	1' x bow	0.305
6	2 (NAVY)	26,390	26 810	1' x bow	0.305
7	4 (SSPA)	17,270	17 550	3.75' x stern	1.143
8	4 (SSPA)	26,390	26 810	1' x bow	0.305

*Leading edge up 2.5 degrees

Ship Speed = 20 knots

Propeller Diameter = 21 feet (6.40 m)

APPENDIX A

EXPERIMENT 1 Repeat 10/80

FIN CONFIGURATION none

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

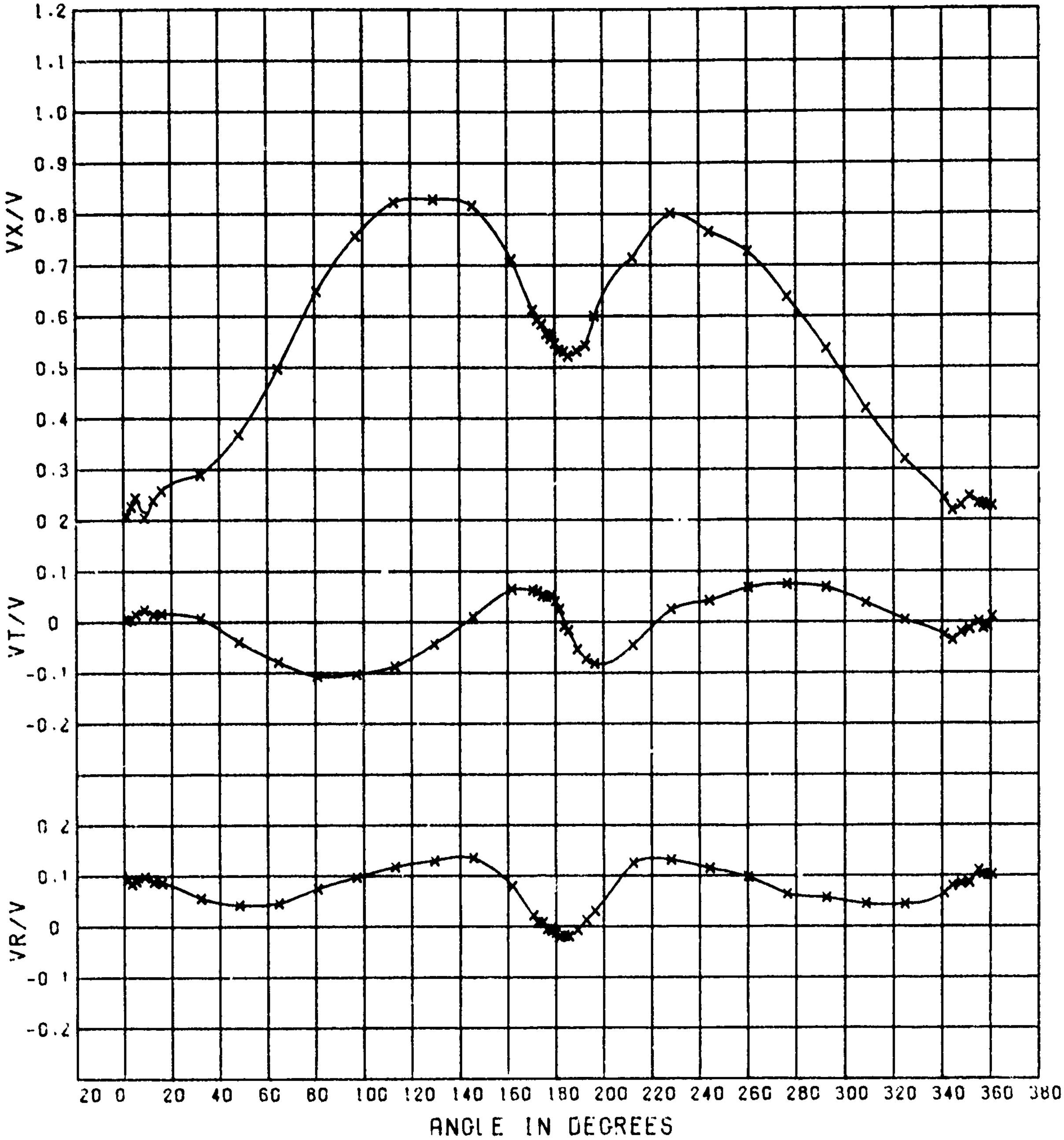


Figure A1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 1 (10/80) Radius Ratio = 0.359

Fin Configuration None
Displacement 26,390 tons (26 810 metric tons)

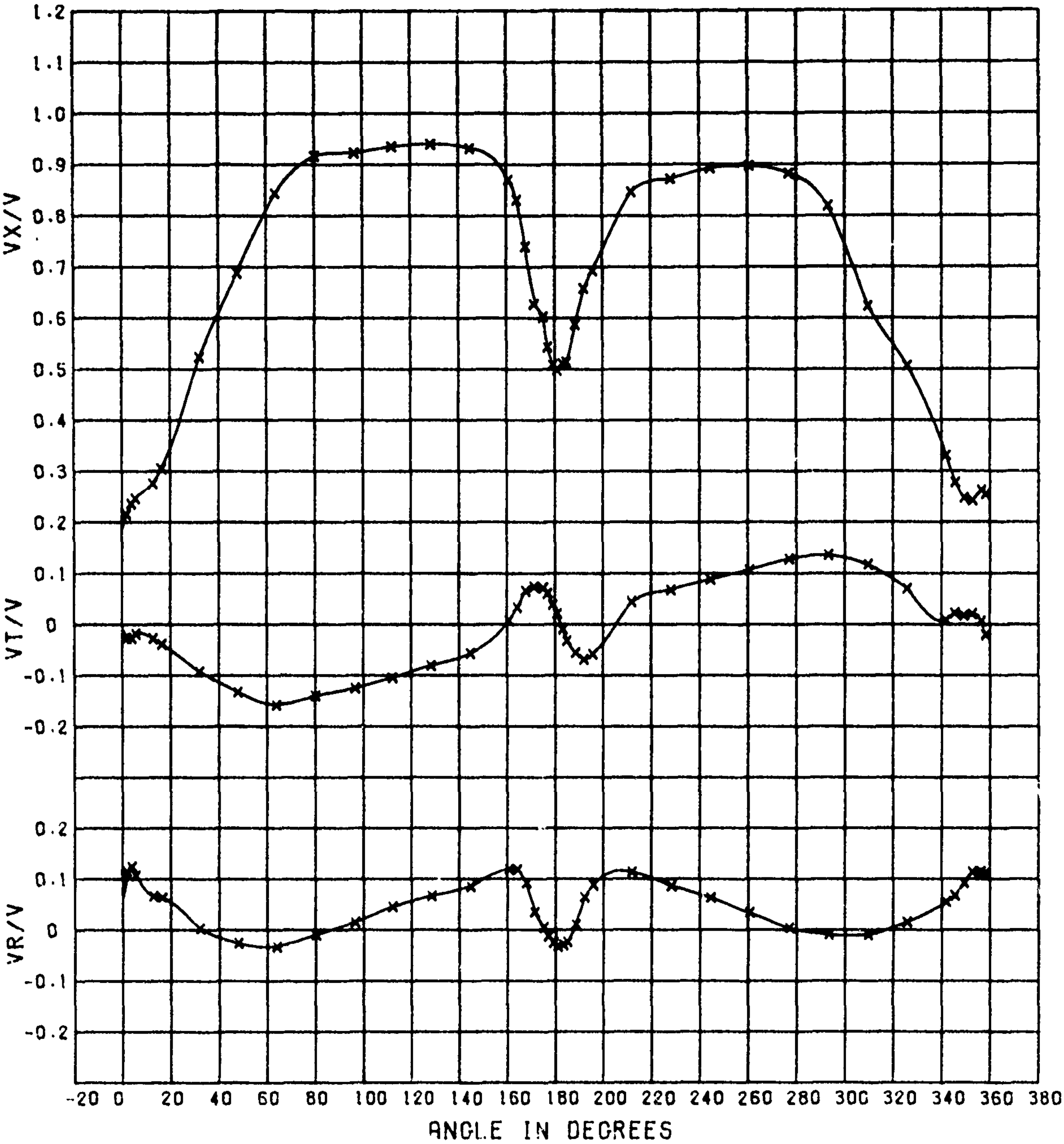


Figure A2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 1 (10/80) Radius Ratio = 0.556

Fin Configuration	None
Displacement	26,390 tons (26 810 metric tons)

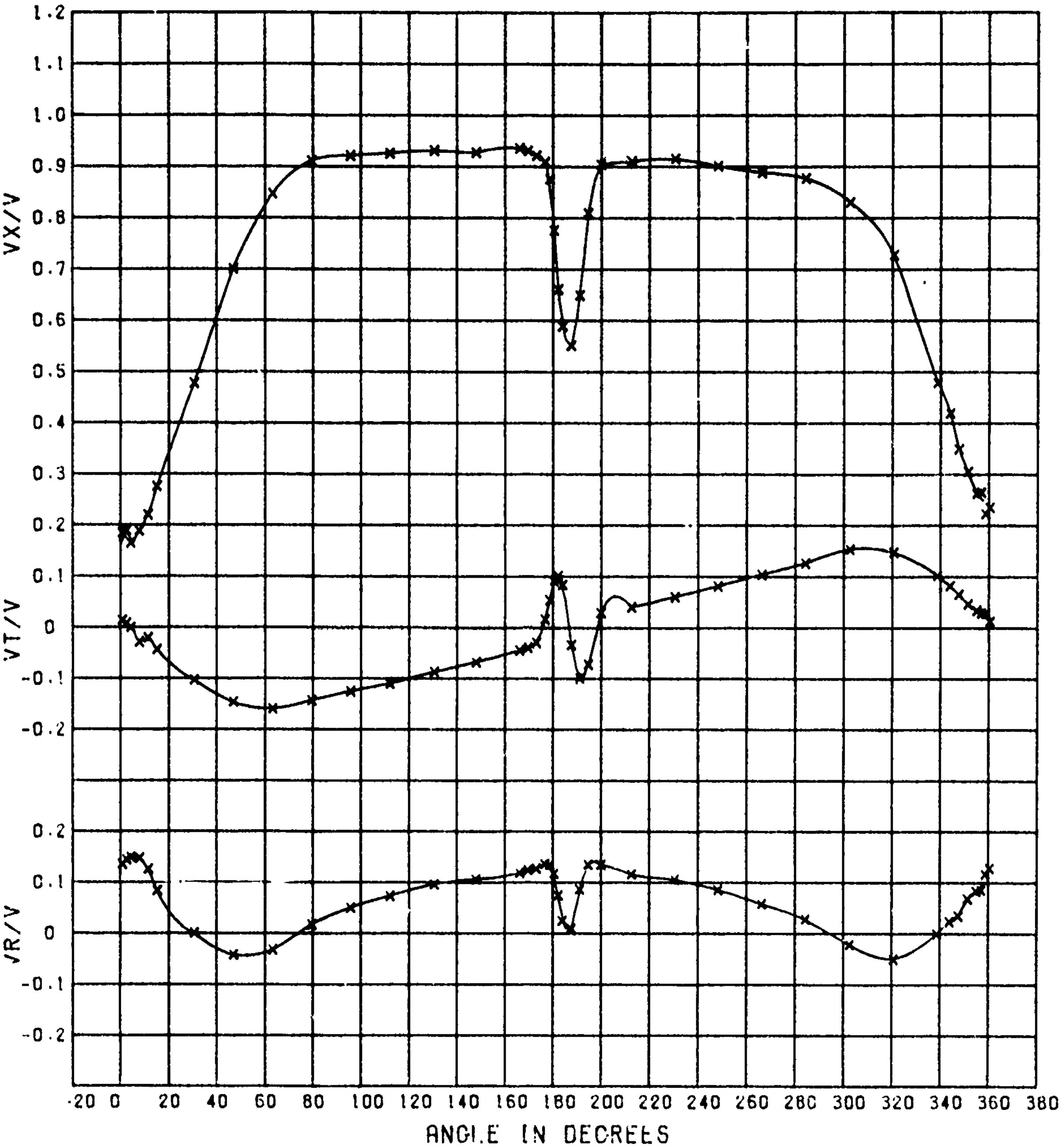


Figure A3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 1 (10/80) Radius Ratio = 0.775

Fin Configuration	None
Displacement	26,390 tons (26 810 metric tons)

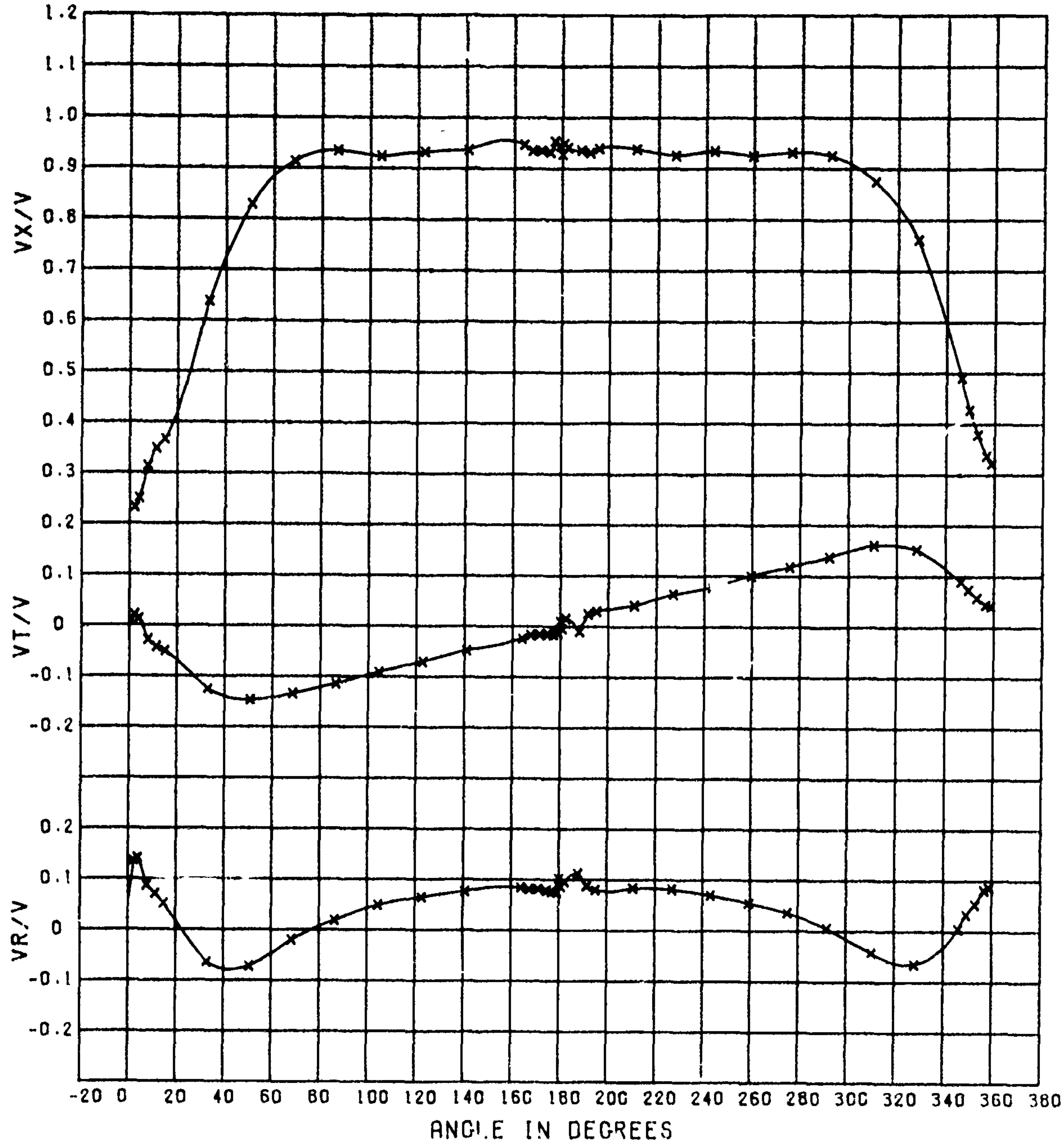


Figure A4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 1 (10/80) Radius Ratio = 1.107

Fin Configuration None

Displacement 26,390 tons (26 810 metric tons)

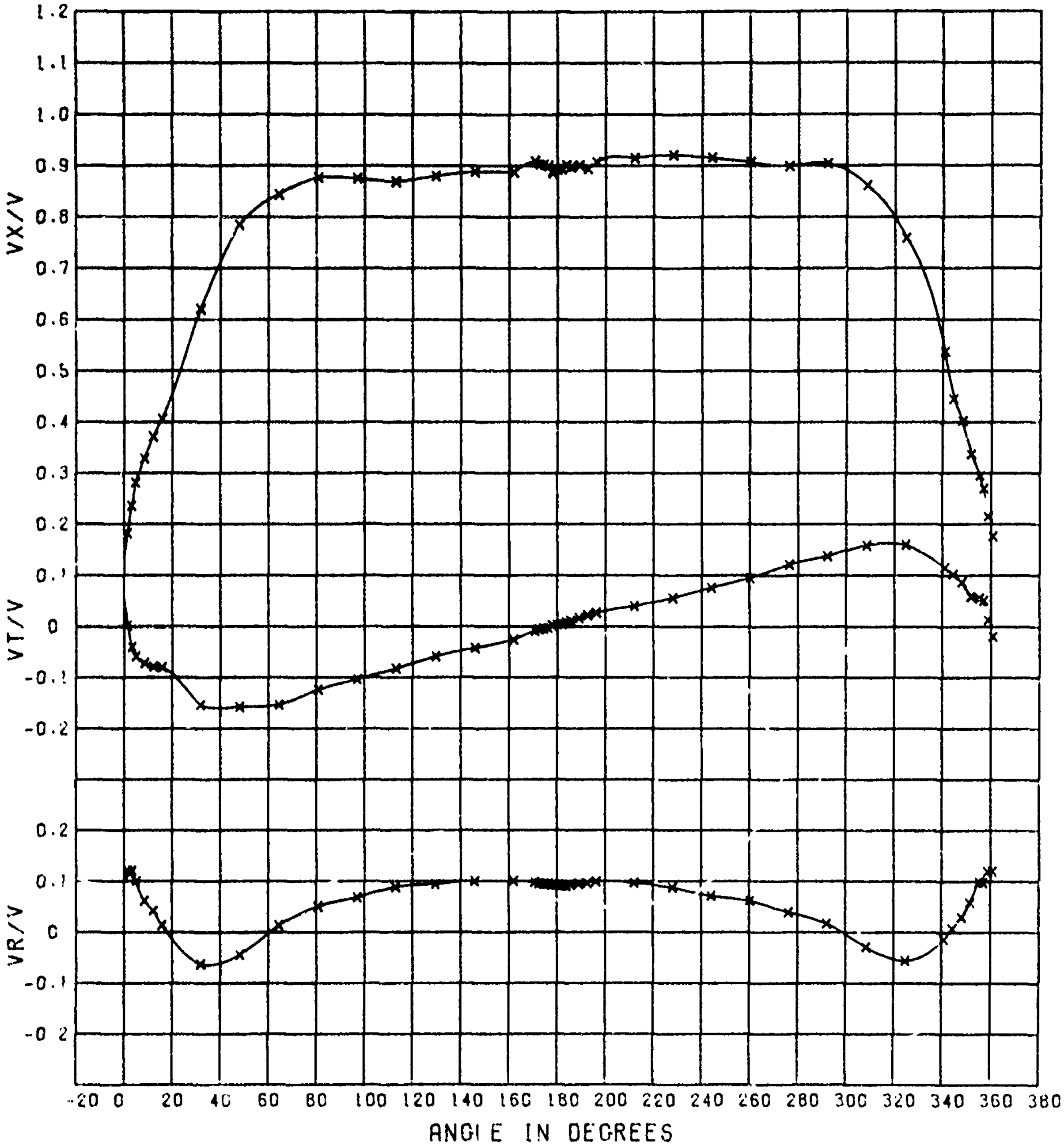


Figure A5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 1 (10/80) Radius Ratio = 1.178

Fin Configuration None
Displacement 26,390 tons (26 810 metric tons)

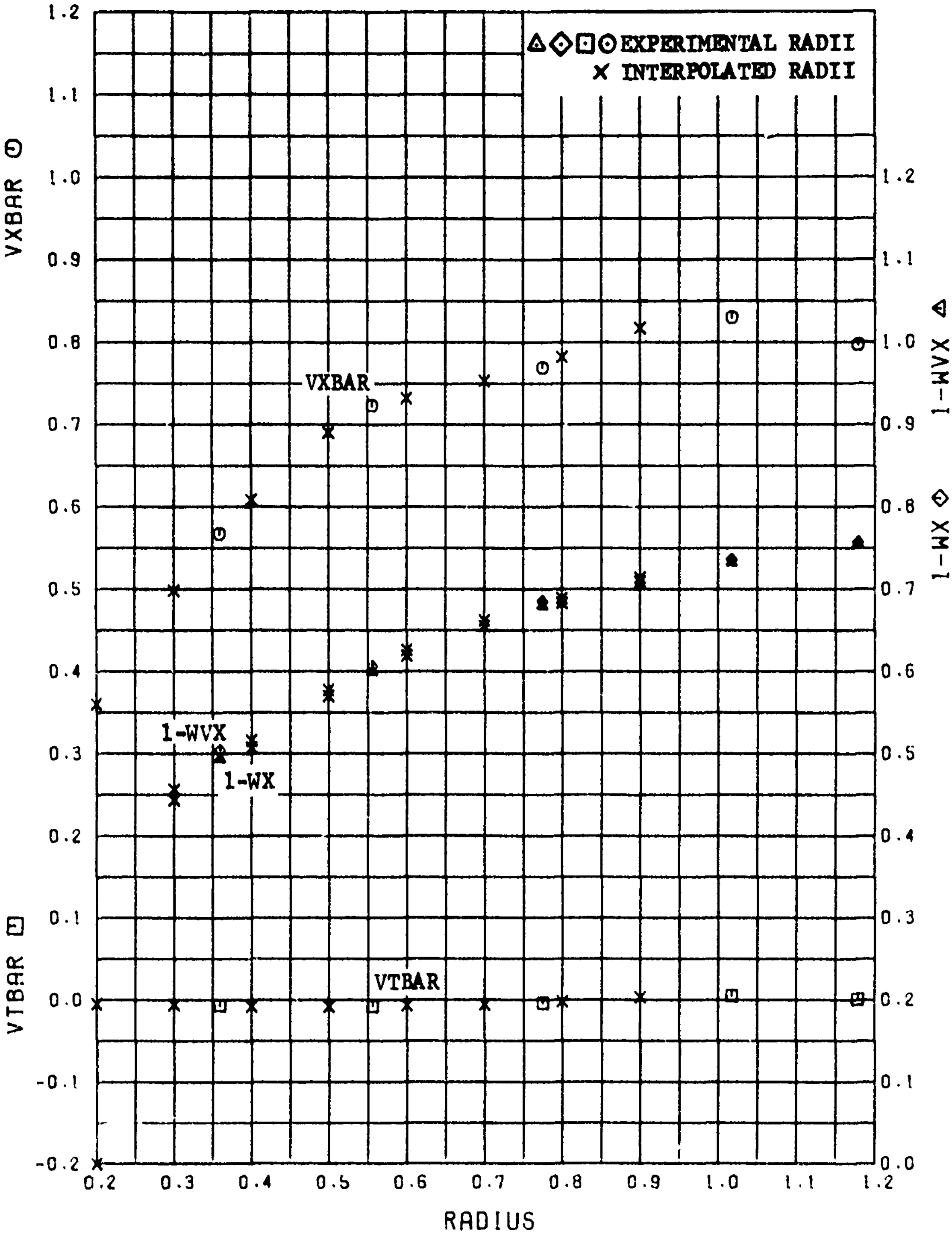


Figure A6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 1 (10/80)

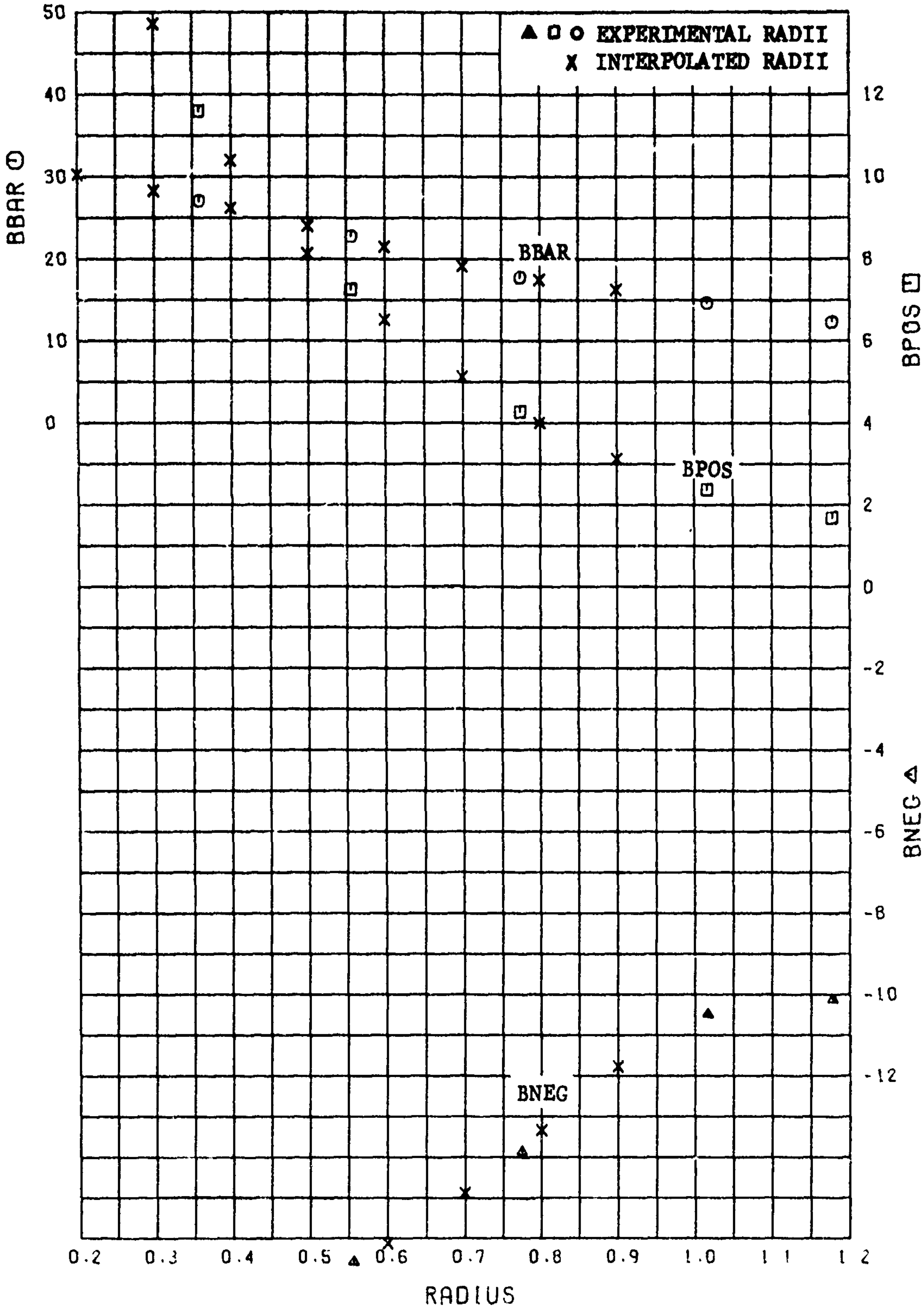


Figure A7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 1 (10/80)

Table A1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 1 Repeat (10/80) without Fins

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.567	.723	.769	.830	.797	.360	.498	.608	.690	.732	.753	.782	.817
VTBAR =	-.007	-.003	-.004	.005	.001	-.005	-.006	-.008	-.008	-.007	-.006	-.002	.003
VRBAR =	.078	.039	.053	.031	.045	.143	.098	.066	.045	.045	.052	.048	.035
1-WVX =	.493	.599	.679	.732	.754	0.000	.443	.507	.570	.619	.655	.683	.709
1-WX =	.504	.606	.685	.736	.757	0.000	.456	.516	.577	.626	.662	.689	.714
BBAR =	27.05	22.79	17.73	14.67	12.27	30.26	29.27	26.19	24.03	21.49	19.12	17.46	16.25
BPOS =	11.60	7.26	4.27	2.37	1.66	22.05	13.72	10.40	8.13	6.52	5.12	4.00	3.12
THETA =	115.00	85.00	87.50	82.50	170.00	220.00	115.00	115.00	112.50	87.50	87.50	87.50	85.00
BNEG =	-16.94	-16.58	-13.87	-10.49	-10.13	-38.71	-18.38	-17.14	-16.97	-16.12	-14.89	-13.34	-11.77
THETA =	0.00	0.00	0.00	2.50	0.00	42.50	32.50	0.00	0.00	0.00	0.00	5.00	2.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table A2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 1 Repeat (10/80) without Fins

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.2433	-.1424	.0576	-.0236	.0199	-.0144	.0053	-.0049
RADIUS = .556 AMPLITUDE =	-.1999	-.2264	-.0170	-.0587	.0316	-.0335	.0122	-.0212
RADIUS = .775 AMPLITUDE =	-.2191	-.1832	-.0675	-.0641	.0015	-.0257	.0076	-.0158
RADIUS = 1.017 AMPLITUDE =	-.1921	-.1404	-.0946	-.0514	-.0239	-.0165	-.0080	-.0074
RADIUS = 1.178 AMPLITUDE =	-.1830	-.1354	-.0924	-.0573	-.0303	-.0198	-.0128	-.0088

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.3203	.0104	.1380	.0256	-.0165	.0191	-.0079	.0230
RADIUS = .300 AMPLITUDE =	-.2675	-.0945	.0853	-.0075	.0092	-.0038	.0012	.0039
RADIUS = .400 AMPLITUDE =	-.2295	-.1695	.0398	-.0332	.0253	-.0204	.0076	-.0100
RADIUS = .500 AMPLITUDE =	-.2064	-.2144	.0014	-.0516	.0320	-.0306	.0113	-.0187
RADIUS = .600 AMPLITUDE =	-.2071	-.2174	-.0291	-.0611	.0250	-.0320	.0120	-.0203
RADIUS = .700 AMPLITUDE =	-.2172	-.1975	-.0529	-.0641	.0110	-.0285	.0102	-.0179
RADIUS = .800 AMPLITUDE =	-.2155	-.1768	-.0719	-.0616	-.0020	-.0240	.0056	-.0143
RADIUS = .900 AMPLITUDE =	-.2031	-.1558	-.0860	-.0543	-.0140	-.0188	-.0017	-.0099

Table A3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 1 Repeat (10/80) without Fins

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.0561	-.0122	.0483	-.0102	.0197	-.0087	.0076	-.0024
RADIUS = .556 AMPLITUDE =	-.1233	-.0287	.0149	-.0021	.0199	-.0111	.0119	-.0112
RADIUS = .775 AMPLITUDE =	-.1364	-.0388	-.0143	-.0006	.0038	-.0011	.0032	-.0044
RADIUS = 1.017 AMPLITUDE =	-.1294	-.0464	-.0207	-.0045	-.0014	.0020	.0007	.0005
RADIUS = 1.178 AMPLITUDE =	-.1324	-.0545	-.0244	-.0079	-.0046	-.0008	-.0016	-.0011

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.0364	.0062	.0803	-.0212	.0094	.0011	-.0043	.0150
RADIUS = .300 AMPLITUDE =	-.0258	-.0059	.0597	-.0138	.0169	-.0059	.0041	.0030
RADIUS = .400 AMPLITUDE =	-.0744	-.0162	.0408	-.0030	.0209	-.0101	.0094	-.0054
RADIUS = .500 AMPLITUDE =	-.1096	-.0247	.0237	-.0038	.0212	-.0115	.0119	-.0102
RADIUS = .600 AMPLITUDE =	-.1274	-.0309	.0072	-.0014	.0158	-.0085	.0097	-.0097
RADIUS = .700 AMPLITUDE =	-.1340	-.0356	-.0068	-.0006	.0081	-.0037	.0055	-.0064
RADIUS = .800 AMPLITUDE =	-.1350	-.0393	-.0150	-.0009	.0032	-.0004	.0030	-.0035
RADIUS = .900 AMPLITUDE =	-.1311	-.0421	-.0177	-.0024	.0010	.0016	.0020	-.0008

Table A4 - Input Data for Wake Survey Analysis Experiment 1 Repeat (10/80) without Fins

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
1.3	.208	.003	.092
3.1	.227	.005	.085
4.9	.244	.015	.090
6.5	.205	.024	.098
12.2	.238	.015	.087
15.8	.258	.016	.086
31.9	.291	.012	.055
31.3	.286	.003	.056
46.1	.368	-.040	.042
64.5	.497	-.079	.046
80.7	.648	-.107	.074
97.1	.757	-.103	.097
113.2	.823	-.038	.117
129.6	.828	-.044	.129
145.8	.815	.010	.135
161.9	.711	.064	.080
178.1	.556	.031	-.008
170.8	.612	.063	.022
172.6	.592	.060	.008
174.5	.583	.052	.009
175.4	.565	.049	-.006
178.1	.565	.051	-.004
180.0	.546	.040	-.014
181.8	.543	.025	-.021
183.7	.530	-.009	-.019
185.5	.522	-.017	-.020
169.1	.532	-.054	-.007
192.7	.543	-.073	.012
193.3	.600	-.082	.030
212.2	.714	-.045	.125
228.1	.802	.025	.131
244.1	.765	.041	.115
260.2	.747	.069	.098
276.4	.637	.074	.064
292.5	.536	.069	.056
300.8	.419	.038	.044
324.9	.319	.004	.044
340.9	.242	-.025	.065
344.4	.218	-.036	.090
348.1	.229	-.020	.085
351.6	.246	-.014	.086
355.3	.233	.001	.111
357.0	.231	-.012	.102
358.8	.227	-.009	.101
360.7	.227	.011	.102
362.5	.248	.014	.088

RADIUS = .558

ANGLE	VX/V	VT/V	VR/V
1.8	.215	-.027	.114
3.8	.235	-.027	.124
5.5	.246	-.018	.106
12.9	.275	-.028	.066
16.5	.305	-.039	.063
32.2	.524	-.092	.002
48.0	.688	-.133	-.026
64.0	.844	-.159	-.034
80.1	.916	-.141	-.010
96.6	.922	-.125	.014
112.4	.935	-.105	.045
128.7	.939	-.081	.066
144.9	.931	-.057	.085
160.9	.870	.008	.119
164.5	.830	.033	.118
168.1	.740	.066	.092
171.6	.627	.074	.035
175.3	.602	.071	.005
177.0	.543	.060	-.012
178.9	.522	.045	-.026
179.5	.495	.031	-.026
180.6	.501	.027	-.031
181.3	.495	.014	-.036
183.2	.511	-.010	-.030
184.9	.514	-.033	-.024
188.6	.537	-.055	.011
192.1	.658	-.060	.064
195.8	.692	-.058	.069
211.9	.846	.044	.113
228.1	.871	.067	.086
244.5	.892	.088	.063
260.6	.896	.106	.033
277.1	.895	.127	.005
277.1	.809	.128	.003
293.3	.819	.136	-.009
309.6	.623	.117	-.010
325.8	.506	.070	.015
341.9	.331	.008	.055
345.5	.277	.021	.067
349.2	.247	.017	.091
352.8	.242	.020	.114
356.5	.252	.006	.114
358.2	.254	-.021	.110
360.0	.174	.009	0.000

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
.8	.185	.014	.136
2.5	.189	.008	.145
4.4	.165	0.000	.149
7.9	.169	-.029	.148
11.5	.221	-.020	.126
15.1	.276	-.044	.083
30.9	.478	-.103	.001
47.1	.701	-.146	-.042
63.3	.848	-.159	-.032
79.5	.911	-.143	.017
95.7	.921	-.125	.051
112.1	.926	-.110	.073
130.5	.932	-.087	.096
148.1	.928	-.067	.105
166.1	.936	-.044	.119
169.6	.931	-.009	.124
173.2	.922	-.029	.127
176.8	.910	.017	.136
178.7	.876	.055	.135
180.5	.777	.092	.118
182.2	.661	.102	.075
184.0	.589	.084	.025
187.6	.551	-.034	.010

Table A4 - Continued

191.1	.650	-.099	.067
194.7	.610	-.072	.135
200.0	.905	.030	.135
212.7	.911	.040	.116
230.6	.916	.060	.106
248.4	.901	.081	.086
266.4	.889	.104	.058
284.5	.878	.126	.028
302.7	.831	.154	-.022
320.7	.729	.148	-.050
338.8	.479	.102	-.000
344.1	.420	.082	.024
347.7	.350	.066	.035
351.4	.305	.047	.069
354.9	.262	.030	.084
355.0	.263	.039	.083
356.9	.265	.029	.086
358.7	.223	.029	.117
360.5	.235	.013	.128
362.3	.168	.007	.144

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
2.2	.231	.021	.135
4.0	.250	.013	.141
7.6	.314	-.029	.096
11.1	.348	-.043	.070
14.7	.366	-.051	.051
32.7	.637	-.127	-.065
50.6	.828	-.143	-.073
68.4	.913	-.135	-.020
86.4	.934	-.115	.018
104.5	.923	-.092	.048
122.7	.952	-.071	.064
140.7	.936	-.048	.075
164.1	.946	-.024	.084
167.7	.934	-.017	.081
171.4	.935	-.016	.081
174.9	.932	-.015	.079
176.9	.953	-.017	.075
178.7	.940	-.011	.074
179.2	.938	-.017	.075
179.5	.898	.024	.120
180.5	.956	-.004	.084
180.8	.949	-.005	.086
182.3	.944	.013	.095
183.5	.937	.019	.096
187.9	.935	-.011	.112
191.5	.930	.024	.087
195.1	.938	.029	.079
210.9	.938	.041	.084
227.1	.925	.064	.081
243.3	.934	.077	.070
259.5	.925	.100	.054
275.7	.931	.118	.035
292.1	.925	.137	[illegible]
310.5	.873	.160	-.043
328.1	.761	.152	-.066
346.1	.491	.090	.005
349.6	.427	.074	.033
353.2	.378	.058	.053
356.8	.336	.044	.082
358.7	.321	.041	.086
362.2	.231	.021	.135

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
1.3	.182	.001	.120
3.1	.236	-.041	.120
4.9	.281	-.059	.099
8.5	.329	-.073	.061
12.2	.371	-.079	.042
15.8	.407	-.081	.014
31.9	.612	-.150	-.060
31.9	.628	-.158	-.066
48.1	.785	-.153	-.045
64.5	.843	-.154	.013
80.7	.876	-.124	.049
97.1	.875	-.105	.067
113.2	.869	-.083	.088
129.6	.880	-.059	.094
145.8	.887	-.043	.100
161.9	.887	-.026	.101
178.1	.886	.002	.092
170.8	.909	-.008	.098
172.6	.901	-.006	.095
174.5	.902	-.004	.095
176.4	.899	-.004	.094
178.1	.899	.002	.094
180.0	.892	.003	.092
181.8	.893	.004	.091
183.7	.900	.007	.091
185.5	.897	.010	.093
189.1	.901	.016	.094
192.7	.894	.022	.096
196.3	.907	.027	.099
212.2	.915	.040	.097
228.1	.921	.055	.087
244.1	.915	.076	.071
260.2	.906	.094	.062
276.4	.899	.121	.039
292.5	.904	.137	.017
308.8	.861	.158	-.029
324.8	.759	.160	-.057
340.9	.538	.115	-.014
344.4	.445	.102	.007
348.1	.402	.086	.029
351.6	.336	.058	.058
355.3	.294	.055	.099
357.0	.269	.051	.093
358.8	.215	.013	.119
360.7	.176	-.020	.120
362.5	.253	-.049	.126

APPENDIX B

EXPERIMENT 2

FIN CONFIGURATION 1 (NAVY)

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

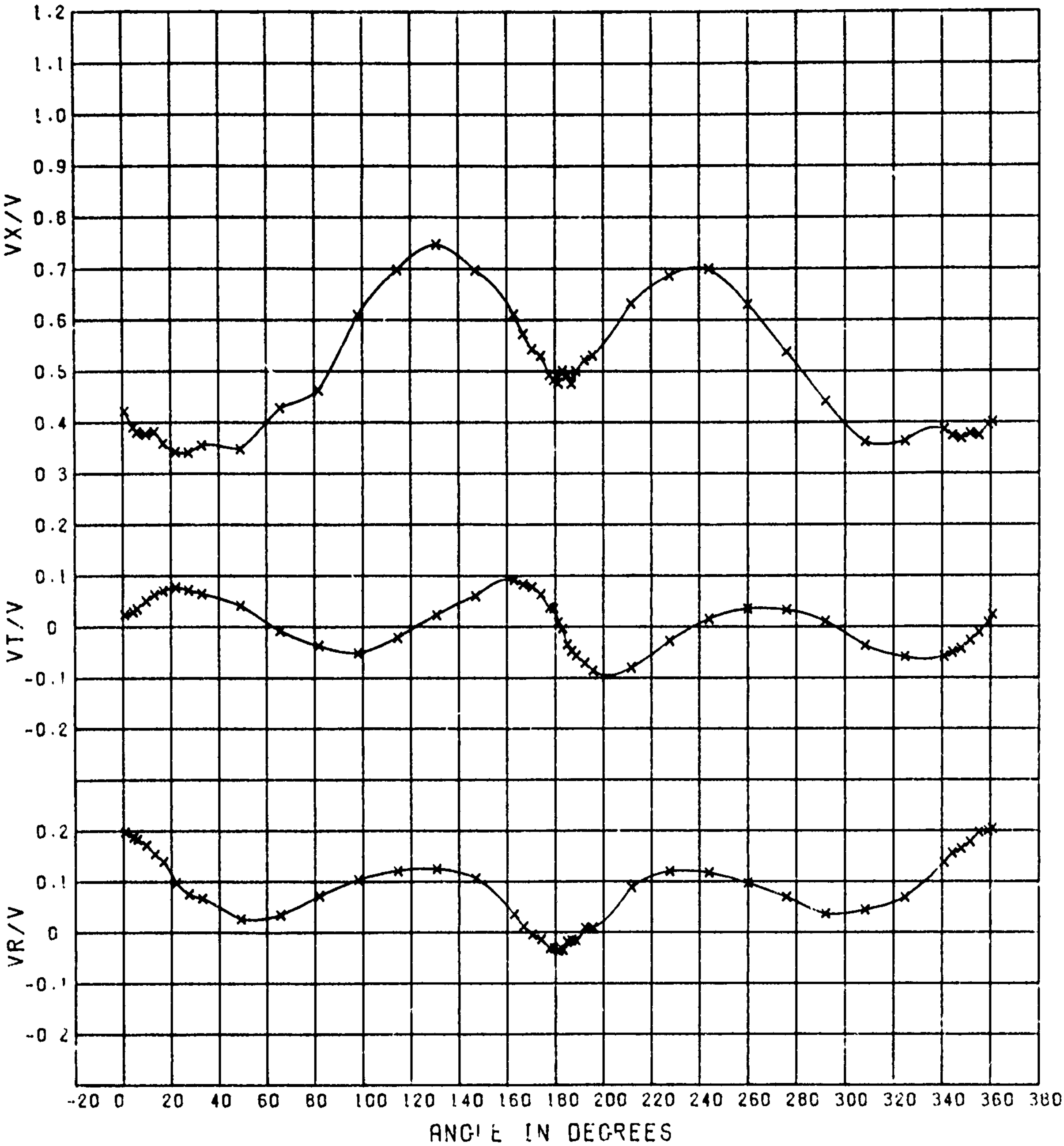


Figure B1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 2
Radius Ratio = 0.359

Fin Configuration 1 (Navy)
Displacement 26,390 tons (26 810 metric tons)

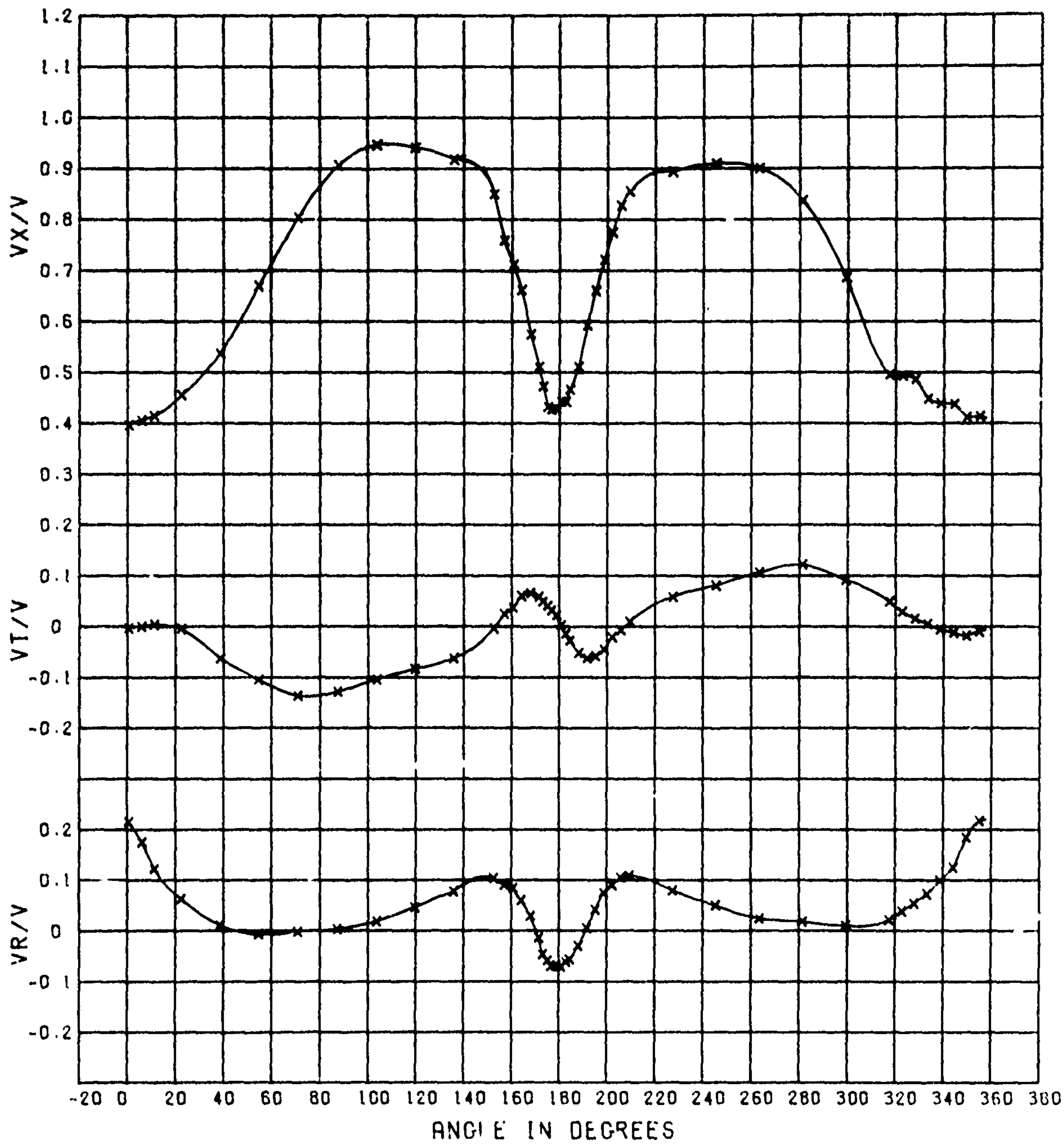


Figure B2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 2
Radius Ratio = 0.556

Fin Configuration 1 (Navy)
Displacement 26,390 tons (26 810 metric tons)

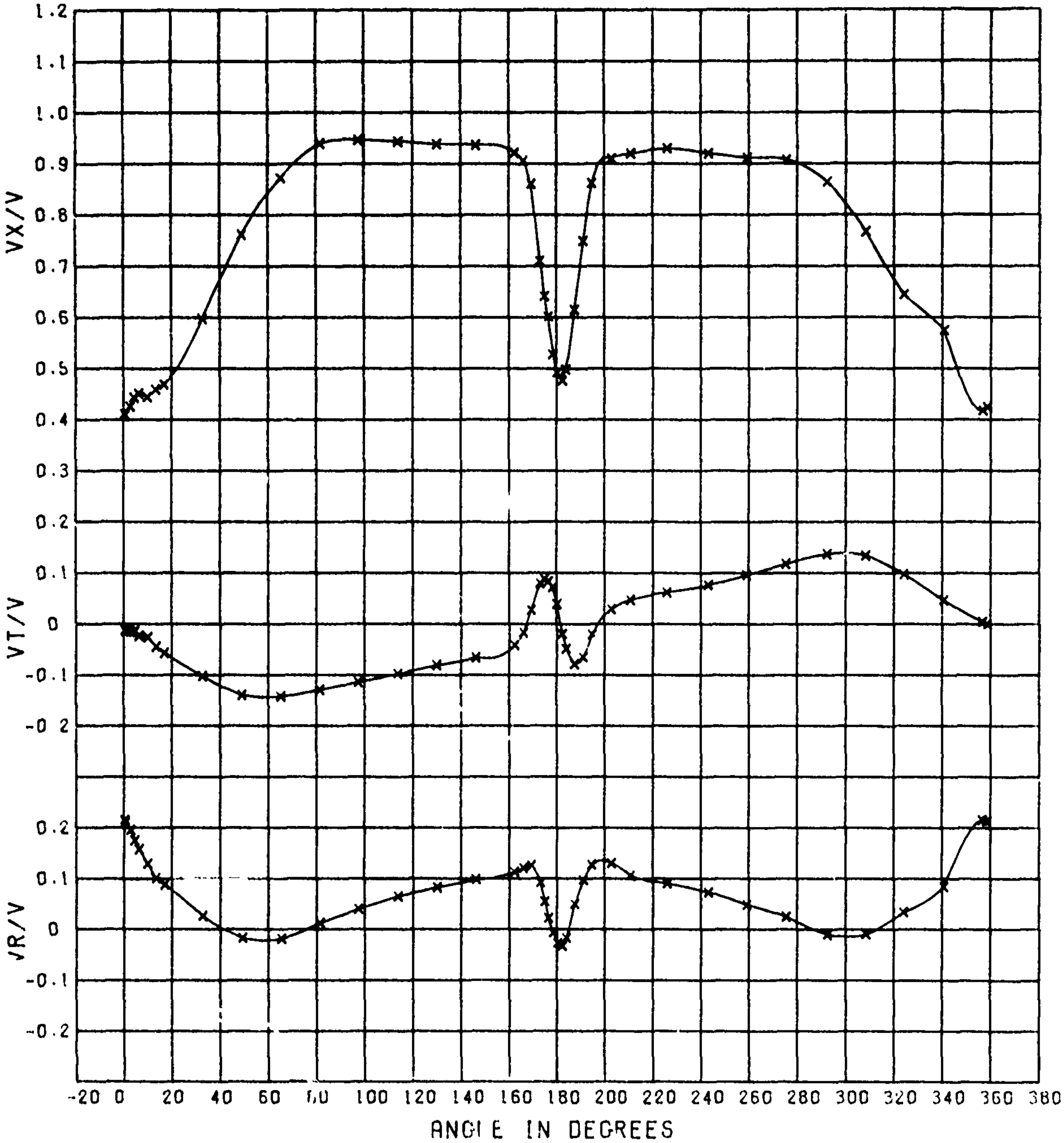


Figure B3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 2
Radius Ratio = 0.775

Fin Configuration 1 (Navy)
Displacement 26,390 tons (26 810 metric tons)

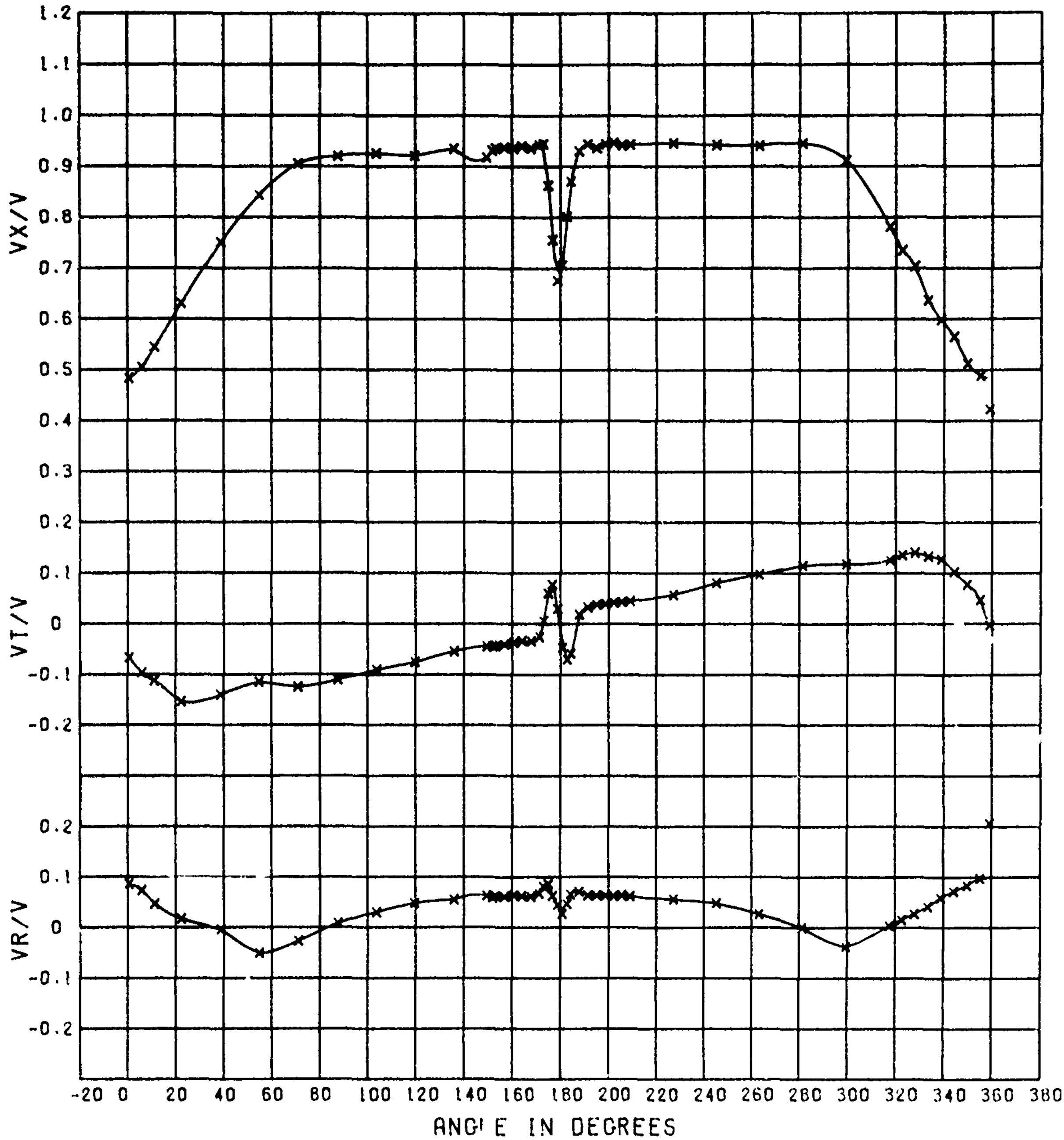


Figure B4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 2
Radius Ratio = 1.107

Fin Configuration 1 (Navy)
Displacement 26,390 tons (26 810 metric tons)

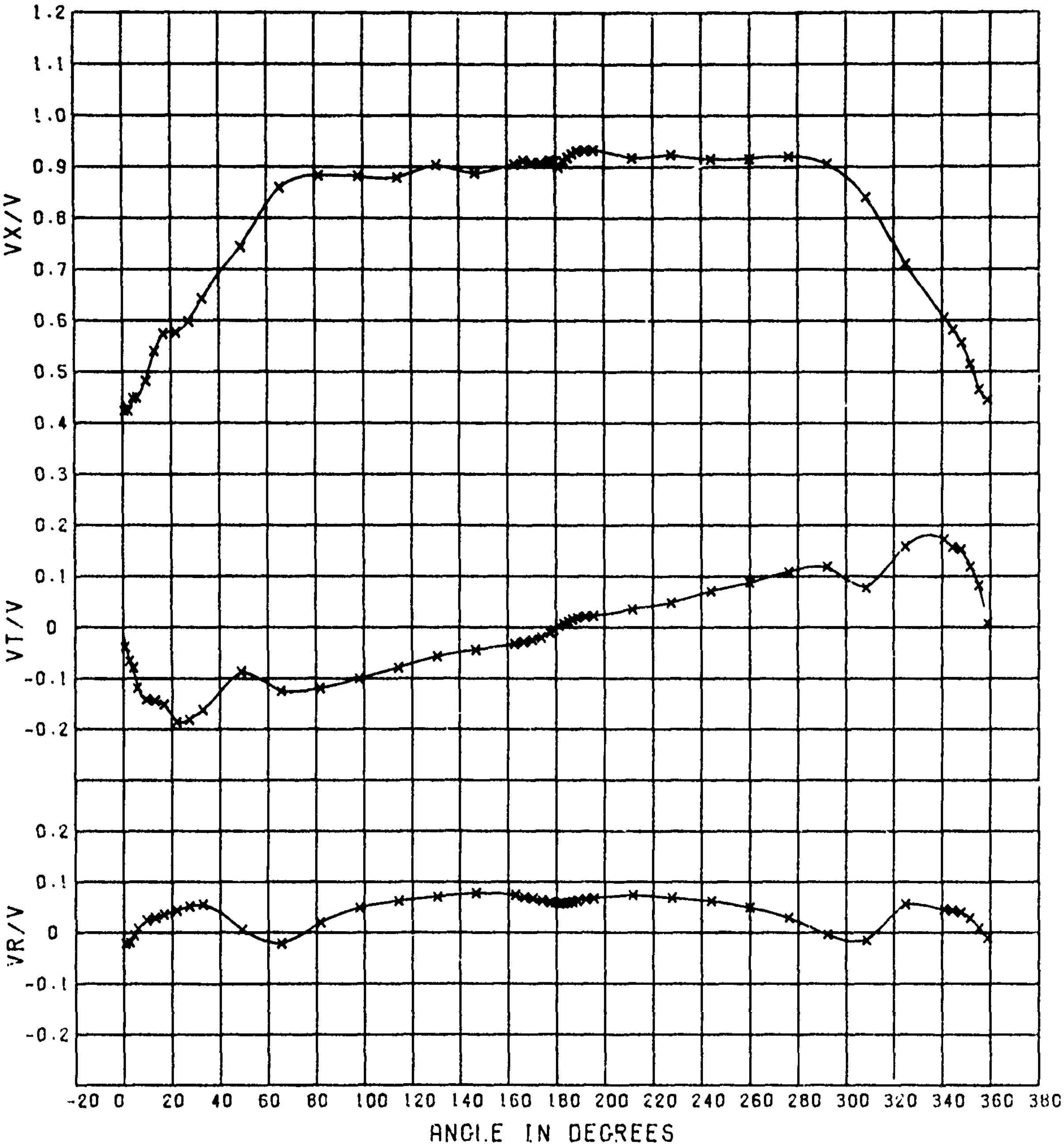


Figure B5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 2
Radius Ratio = 1.178

Fin Configuration 1 (Navy)
Displacement 26,390 tons (26 810 metric tons)

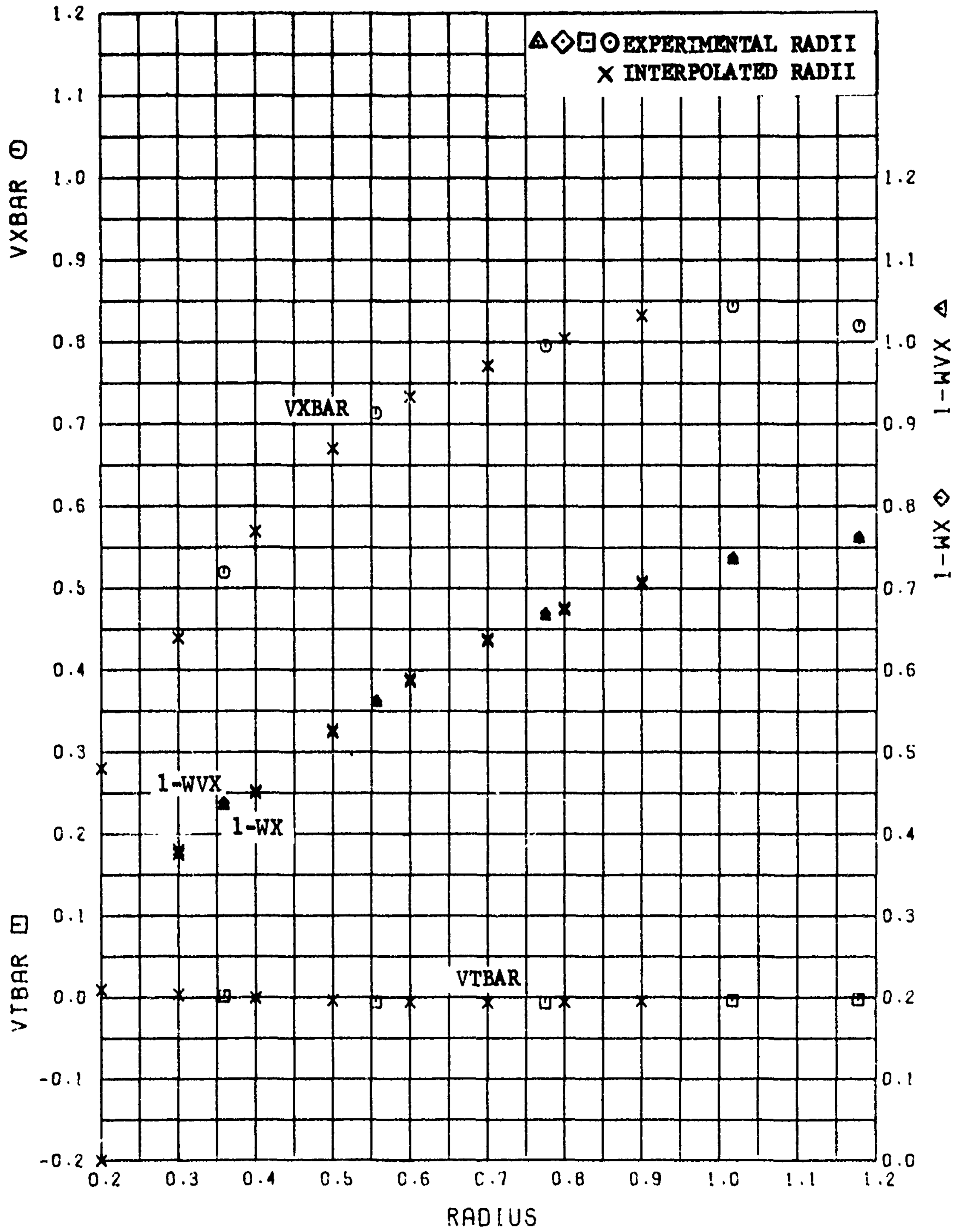


Figure B6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 2

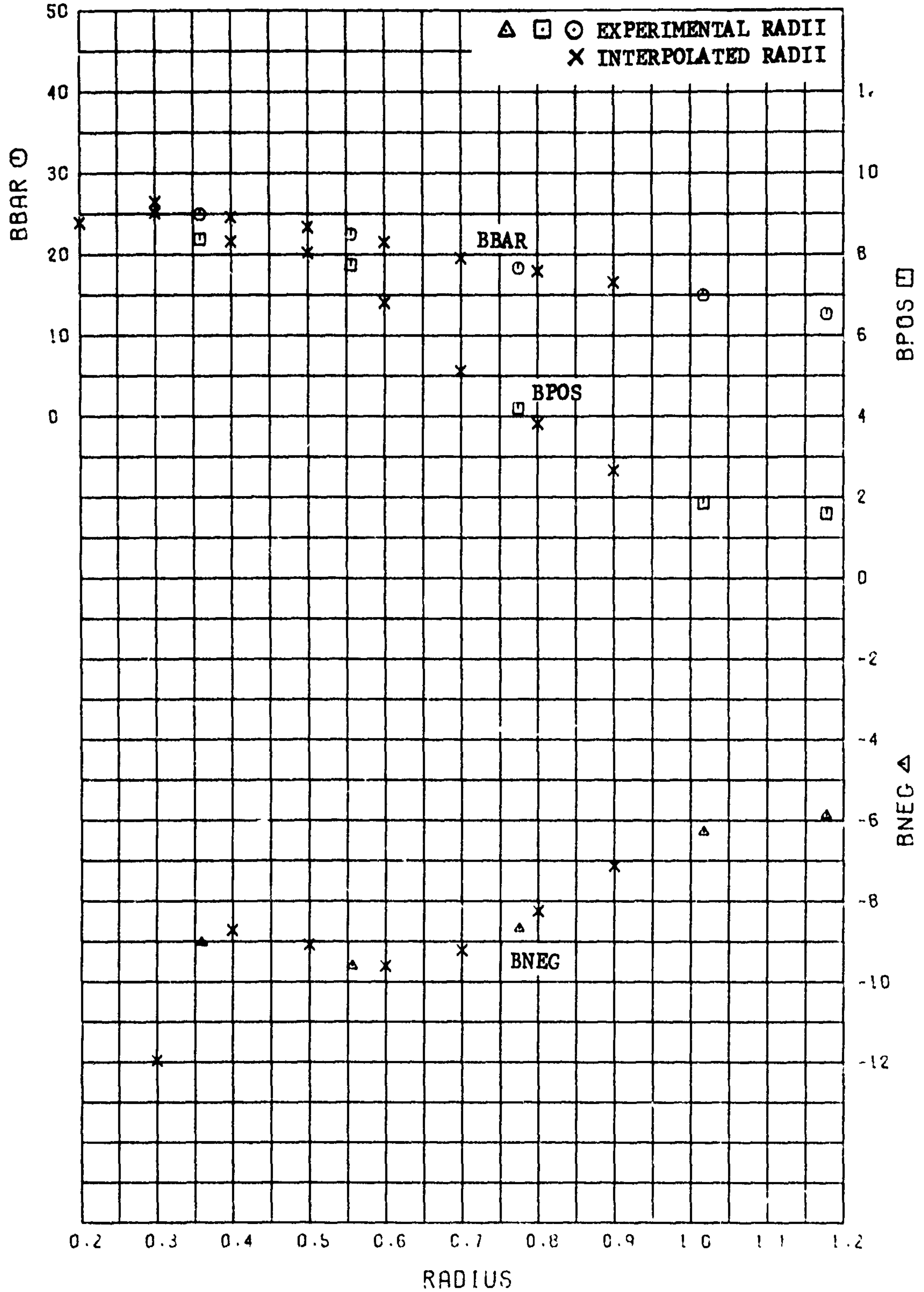


Figure B7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 2

Table B1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 2 with Fin Configuration 1

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.519	.713	.795	.343	.819	.280	.439	.569	.670	.733	.771	.804	.832
VTBAR =	.001	-.006	-.007	-.004	-.003	.003	.003	-.001	-.004	-.006	-.007	-.006	-.005
VRBAR =	.081	.048	.059	.030	.041	.137	.099	.071	.054	.054	.060	.054	.037
1-WVX =	.434	.560	.665	.734	.760	0.000	.375	.450	.524	.586	.635	.673	.705
1-WX =	.438	.562	.659	.737	.762	0.000	.380	.452	.527	.589	.638	.676	.708
BBAR =	24.93	22.48	18.29	14.93	12.61	23.88	25.12	24.60	23.36	21.49	19.55	17.95	16.58
BPOS =	8.38	7.74	4.19	1.85	1.59	23.24	9.29	8.32	8.04	6.81	5.12	3.82	2.67
THETA =	127.50	105.00	90.00	95.00	195.00	175.00	230.00	125.00	110.00	102.50	92.50	90.00	95.00
BNEG =	-9.03	-3.61	-8.68	-6.28	-5.88	-32.61	-11.97	-8.72	-9.08	-9.61	-9.22	-8.25	-7.13
THETA =	25.00	0.00	0.00	355.00	2.50	82.50	50.00	22.50	5.00	0.00	0.00	0.00	355.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table B2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 2 with Fin Configuration 1

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1568	-.0539	.0871	-.0177	.0108	-.0027	.0044	-.0050
RADIUS = .556 AMPLITUDE =	-.1595	-.2017	.0659	-.0362	.0507	-.0354	.0181	-.0180
RADIUS = .775 AMPLITUDE =	-.1544	-.1638	-.0097	-.0488	.0349	-.0351	.0241	-.0292
RADIUS = 1.017 AMPLITUDE =	-.1455	-.1161	-.0475	-.0311	.0039	-.0124	.0051	-.0134
RADIUS = 1.178 AMPLITUDE =	-.1567	-.1004	-.0556	-.0175	-.0032	-.0037	-.0093	-.0075

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.1496	.1912	.0721	.0022	-.0587	.0463	-.0123	.0075
RADIUS = .300 AMPLITUDE =	-.1547	.0240	.0849	-.0108	-.0111	.0131	-.0012	-.0006
RADIUS = .400 AMPLITUDE =	-.1580	-.0988	.0864	-.0221	.0234	-.0121	.0079	-.0079
RADIUS = .500 AMPLITUDE =	-.1595	-.1772	.0764	-.0316	.0446	-.0293	.0150	-.0146
RADIUS = .600 AMPLITUDE =	-.1587	-.1945	.0475	-.0409	.0485	-.0369	.0210	-.0222
RADIUS = .700 AMPLITUDE =	-.1565	-.1774	.0116	-.0476	.0416	-.0373	.0245	-.0281
RADIUS = .800 AMPLITUDE =	-.1520	-.1570	-.0150	-.0471	.0305	-.0322	.0223	-.0272
RADIUS = .900 AMPLITUDE =	-.1459	-.1355	-.0330	-.0400	.0158	-.0219	.0147	-.0200

Table B3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 2 with Fin Configuration 1

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.0118	.0013	.0656	-.0101	.0154	-.0054	.0067	-.0019
RADIUS = .556 AMPLITUDE =	-.0982	-.0124	.0339	-.0002	.0198	-.0118	.0125	-.0060
RADIUS = .775 AMPLITUDE =	-.1255	-.0297	-.0043	.0015	.0095	-.0057	.0087	-.0092
RADIUS = 1.017 AMPLITUDE =	-.1227	-.0426	-.0283	-.0175	-.0173	-.0090	-.0052	-.0021
RADIUS = 1.178 AMPLITUDE =	-.1197	-.0478	-.0335	-.0294	-.0327	-.0199	-.0115	.0000

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.1596	.0112	.0896	-.0238	.0025	.0080	-.0044	.0023
RADIUS = .300 AMPLITUDE =	.0605	.0051	.0747	-.0146	.0116	-.0013	.0033	-.0004
RADIUS = .400 AMPLITUDE =	-.0178	-.0014	.0592	-.0073	.0174	-.0076	.0087	-.0028
RADIUS = .500 AMPLITUDE =	-.0752	-.0083	.0431	-.0022	.0198	-.0111	.0118	-.0050
RADIUS = .600 AMPLITUDE =	-.1059	-.0163	.0249	.0016	.0183	-.0099	.0124	-.0074
RADIUS = .700 AMPLITUDE =	-.1193	-.0244	.0070	.0029	.0145	-.0068	.0109	-.0091
RADIUS = .800 AMPLITUDE =	-.1253	-.0313	-.0077	-.0005	.0065	-.0053	.0070	-.0082
RADIUS = .900 AMPLITUDE =	-.1243	-.0372	-.0191	-.0085	-.0049	-.0055	.0009	-.0050

Table B4 - Input Data for Wake Survey Analysis for Experiment 2 with Fin Configuration 1

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
.7	.422	.024	.197
4.3	.391	.030	.187
6.0	.380	.036	.183
9.7	.377	.051	.172
13.2	.382	.063	.154
16.8	.358	.070	.139
22.1	.342	.077	.097
27.4	.341	.072	.075
32.9	.355	.065	.067
49.2	.348	.042	.027
65.5	.428	-.008	.034
81.8	.463	-.037	.071
98.0	.610	-.052	.103
114.3	.698	-.021	.121
130.6	.747	.023	.124
146.8	.698	.061	.106
162.9	.610	.091	.035
166.6	.572	.083	.011
170.2	.542	.078	-.005
173.9	.530	.063	-.014
177.5	.492	.037	-.032
179.3	.482	.036	-.032
181.1	.476	.008	-.036
183.0	.500	-.004	-.035
184.8	.491	-.035	-.018
186.6	.475	-.048	-.016
188.5	.500	-.037	-.017
192.1	.521	-.071	.009
195.6	.531	-.086	.009
211.6	.632	-.080	.088
227.5	.686	-.028	.119
243.9	.700	.015	.117
260.0	.630	.035	.096
276.2	.537	.033	.069
292.2	.441	.011	.036
308.5	.361	-.037	.044
324.7	.363	-.059	.069
340.9	.386	-.058	.137
344.4	.374	-.050	.156
348.0	.368	-.043	.165
351.6	.378	-.027	.178
355.2	.374	-.011	.197
359.0	.395	.009	.200
360.8	.401	.024	.205

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
.5	.396	-.003	.215
5.9	.406	-.000	.175
11.2	.414	.004	.122
22.5	.455	-.004	.063
38.7	.537	-.063	.011
54.8	.670	-.104	-.007
71.0	.804	-.137	-.002
87.5	.906	-.129	.003
103.7	.947	-.104	.018
119.7	.942	-.084	.046
135.9	.918	-.063	.077
152.0	.858	-.010	.104
153.3	.840	.003	.104
156.9	.759	.025	.090
160.6	.713	.037	.084
164.1	.662	.061	.059
167.8	.569	.062	.020
168.2	.581	.069	.036
171.4	.510	.058	-.014
173.2	.472	.049	-.047
175.1	.432	.041	-.059
176.8	.427	.032	-.070
178.7	.425	.019	-.073
179.1	.431	.026	-.065
180.5	.445	.001	-.073
180.9	.440	.004	-.067
182.7	.441	-.015	-.061
184.4	.466	-.028	-.056
186.0	.511	-.052	-.031
191.5	.593	-.063	.005
195.1	.660	-.059	.042
198.7	.721	-.045	.075
202.2	.774	-.021	.090
205.8	.827	-.007	.105
209.4	.935	.010	.108
227.3	.894	.059	.079
245.3	.909	.081	.050
263.2	.901	.106	.025
281.3	.806	.122	.019
299.4	.636	.092	.010
317.5	.495	.049	.022
322.7	.493	.029	.039
328.0	.487	.016	.054
333.4	.448	.005	.073
338.8	.439	-.005	.099
344.2	.437	-.012	.125
349.6	.412	-.018	.185
355.1	.413	-.010	.217
360.5	.396	-.003	.215

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
.8	.409	-.016	.210
2.7	.426	-.016	.195
4.4	.443	-.015	.174
6.2	.451	-.024	.157
9.3	.444	-.026	.129
13.3	.459	-.045	.101
16.9	.468	-.057	.089
32.8	.598	-.103	.026
49.0	.762	-.139	-.017
65.3	.872	-.142	-.013
81.5	.939	-.129	.012
97.6	.946	-.114	.040
113.9	.943	-.098	.065
130.2	.938	-.081	.083
146.3	.936	-.066	.097
162.4	.921	-.041	.113
166.1	.905	-.017	.120
169.6	.859	.027	.125
173.3	.710	.079	.092
175.2	.641	.088	.054

Table B4 - Continued

176.8	.601	.083	.022
178.6	.527	.072	-.007
180.4	.492	.039	-.027
182.3	.477	-.020	-.033
184.0	.497	-.049	-.017
187.0	.614	-.080	.049
191.2	.748	-.065	.097
194.8	.861	-.020	.127
203.0	.915	.029	.130
211.0	.920	.047	.106
226.0	.930	.062	.089
243.1	.920	.076	.073
259.2	.911	.096	.040
275.4	.907	.118	.025
292.3	.861	.137	-.010
292.3	.866	.137	-.011
308.2	.766	.134	-.010
324.1	.643	.097	.034
340.6	.575	.047	.083
356.7	.418	.004	.216
358.6	.424	.001	.214
.4	.411	-.013	.214
351.6	.444	.010	.165

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
359.0	.422	-.003	.200
.5	.483	-.067	.086
5.9	.505	-.097	.073
11.2	.545	-.113	.046
22.5	.631	-.154	.017
38.7	.750	-.140	-.005
54.8	.843	-.115	-.051
71.0	.905	- 125	-.027
87.5	.920	-.111	.008
103.7	.926	-.091	.030
119.7	.921	-.076	.047
135.9	.935	-.055	.054
152.0	.931	-.045	.058
149.6	.918	-.045	.062
153.3	.936	-.044	.062
153.9	.937	-.040	.060
160.6	.936	-.037	.063
164.1	.910	-.033	.061
167.8	.939	-.034	.062
168.2	.933	-.035	.060
171.4	.942	-.026	.067
173.2	.944	.006	.081
175.1	.862	.060	.083
176.8	.755	.078	.062
173.7	.674	.031	.041
179.1	.677	.029	.043
180.5	.699	-.048	.021
180.9	.714	-.047	.032
182.7	.801	-.071	.046
184.4	.870	-.059	.065
188.0	.930	.018	.070
191.5	.944	.033	.063
195.1	.936	.038	.063
198.7	.944	.039	.062
202.2	.946	.042	.062
205.8	.942	.043	.063
209.4	.943	.045	.061
227.3	.946	.057	.055
245.3	.942	.081	.048
263.2	.941	.097	.026
281.3	.945	.114	-.000
299.4	.912	.118	-.038
317.5	.781	.126	.003
322.7	.735	.136	.015
328.0	.705	.140	.027
333.4	.636	.133	.041
338.8	.598	.128	.058
344.2	.565	.102	.071
349.6	.512	.077	.083
355.1	.489	.047	.097
360.5	.483	-.067	.086

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
.7	.424	-.039	-.021
2.5	.424	-.067	-.019
4.3	.449	-.080	-.005
6.0	.450	-.119	.007
9.7	.481	-.142	.024
13.2	.540	-.144	.029
16.8	.575	-.151	.036
22.1	.577	-.167	.043
27.4	.598	-.181	.051
32.9	.643	-.162	.055
49.2	.743	-.087	.005
65.5	.859	-.125	-.022
81.8	.883	-.119	.020
98.0	.882	-.101	.049
114.3	.878	-.080	.062
130.6	.903	-.057	.070
146.8	.887	-.045	.078
162.9	.905	-.033	.074
166.6	.913	-.029	.069
170.2	.907	-.026	.067
173.9	.907	-.020	.063
177.5	.913	-.010	.059
179.3	.910	-.006	.058
181.1	.849	.003	.057
183.0	.912	.007	.058
184.8	.918	.011	.059
186.6	.925	.016	.061
188.5	.930	.019	.063
192.1	.932	.021	.066
195.6	.933	.022	.067
211.6	.917	.035	.073
227.5	.923	.048	.065
243.9	.915	.071	.062
260.0	.916	.087	.049
276.2	.921	.109	.029
292.2	.906	.119	-.003
308.5	.840	.077	-.016
324.7	.711	.158	.056
340.9	.604	.172	.045
344.4	.581	.156	.043
348.0	.556	.152	.040
351.6	.515	.113	.028
355.2	.465	.082	.009
359.8	.444	.008	-.011

APPENDIX C

EXPERIMENT 3

FIN CONFIGURATION 1 (NAVY)

SHIP VALUES

Trim	3.75 ft by the stern (1.143 m)
Displacement	17,270 tons (17 550 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

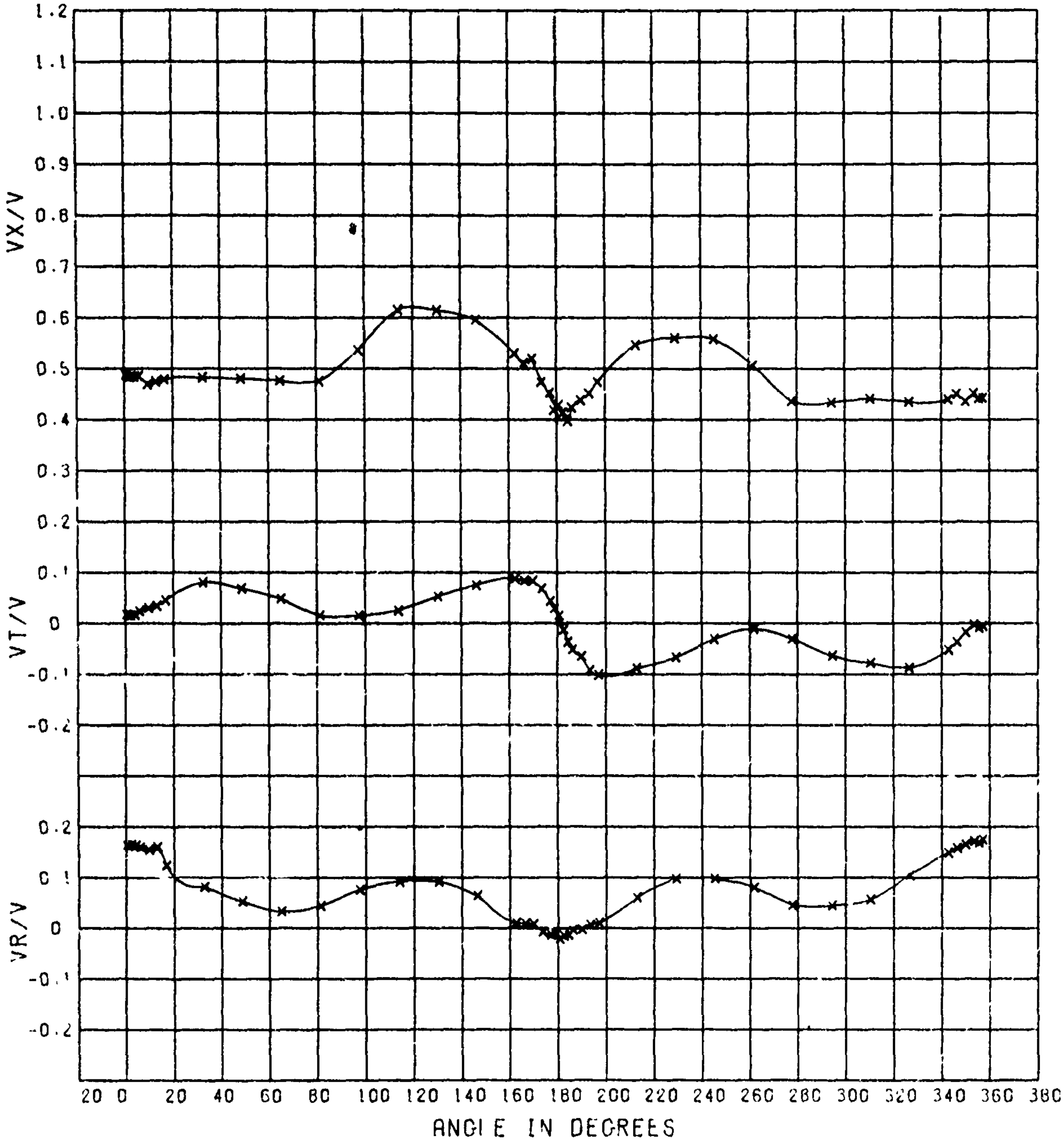


Figure C1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 3
Radius Ratio = 0.359

Fin Configuration 1 (Navy)
Displacement 17,270 tons (17 550 metric tons)

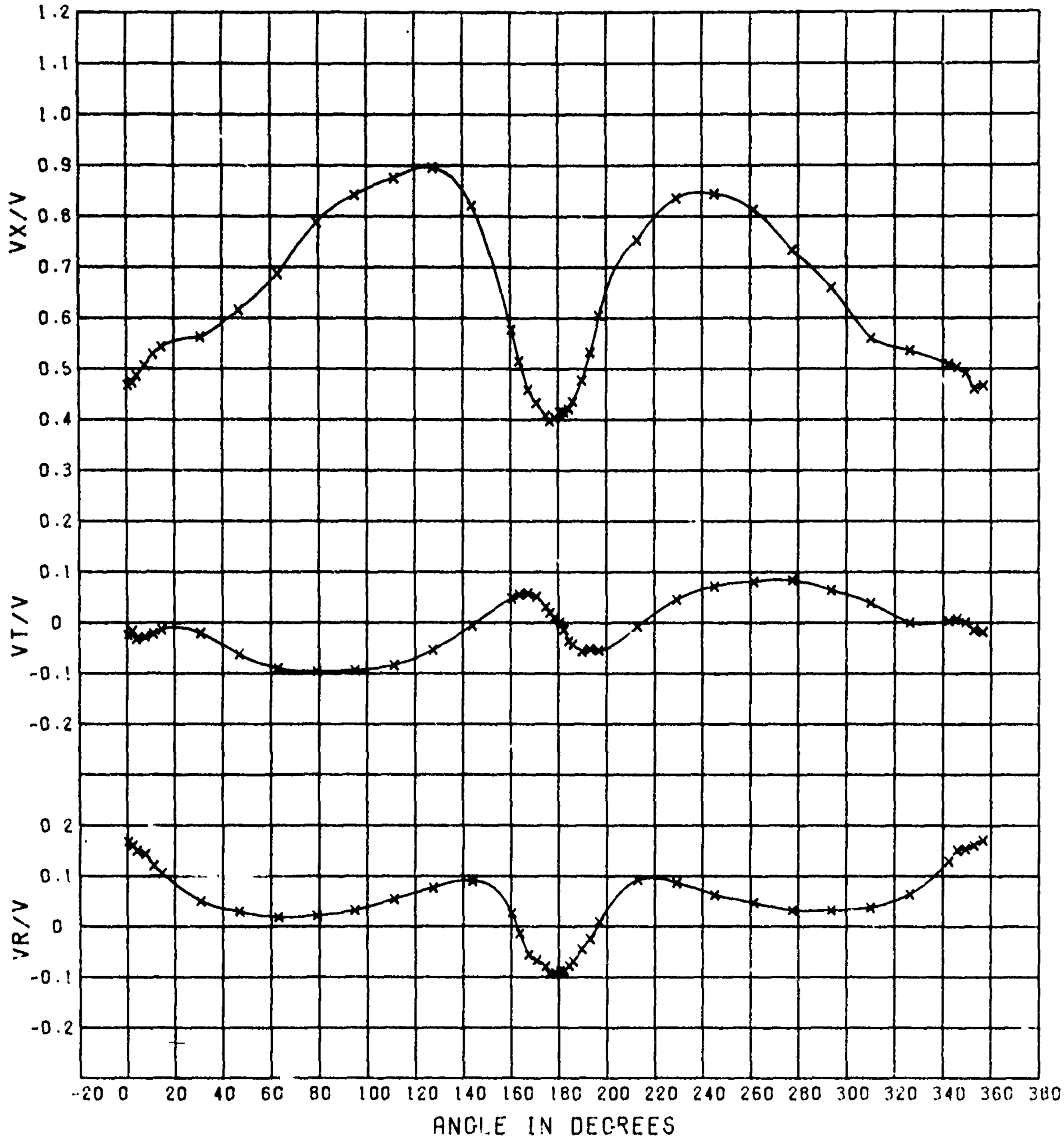


Figure C2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 3
Radius Ratio = 0.556

Fin Configuration 1 (Navy)
Displacement 17,270 tons (17 550 metric tons)

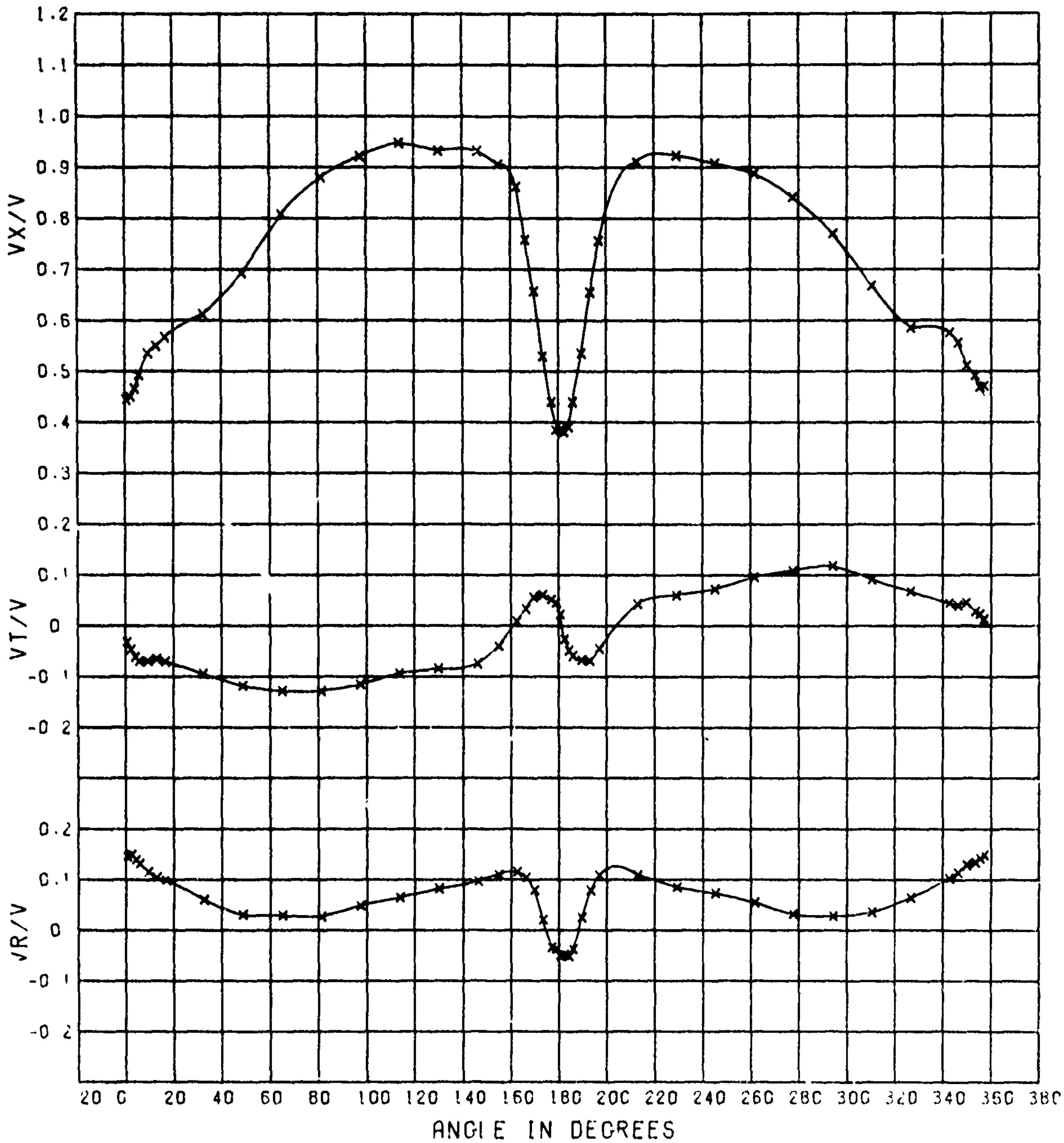


Figure C3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 3
Radius Ratio = 0.775

Fin Configuration 1 (Navy)
Displacement 17,270 tons (17 550 metric tons)

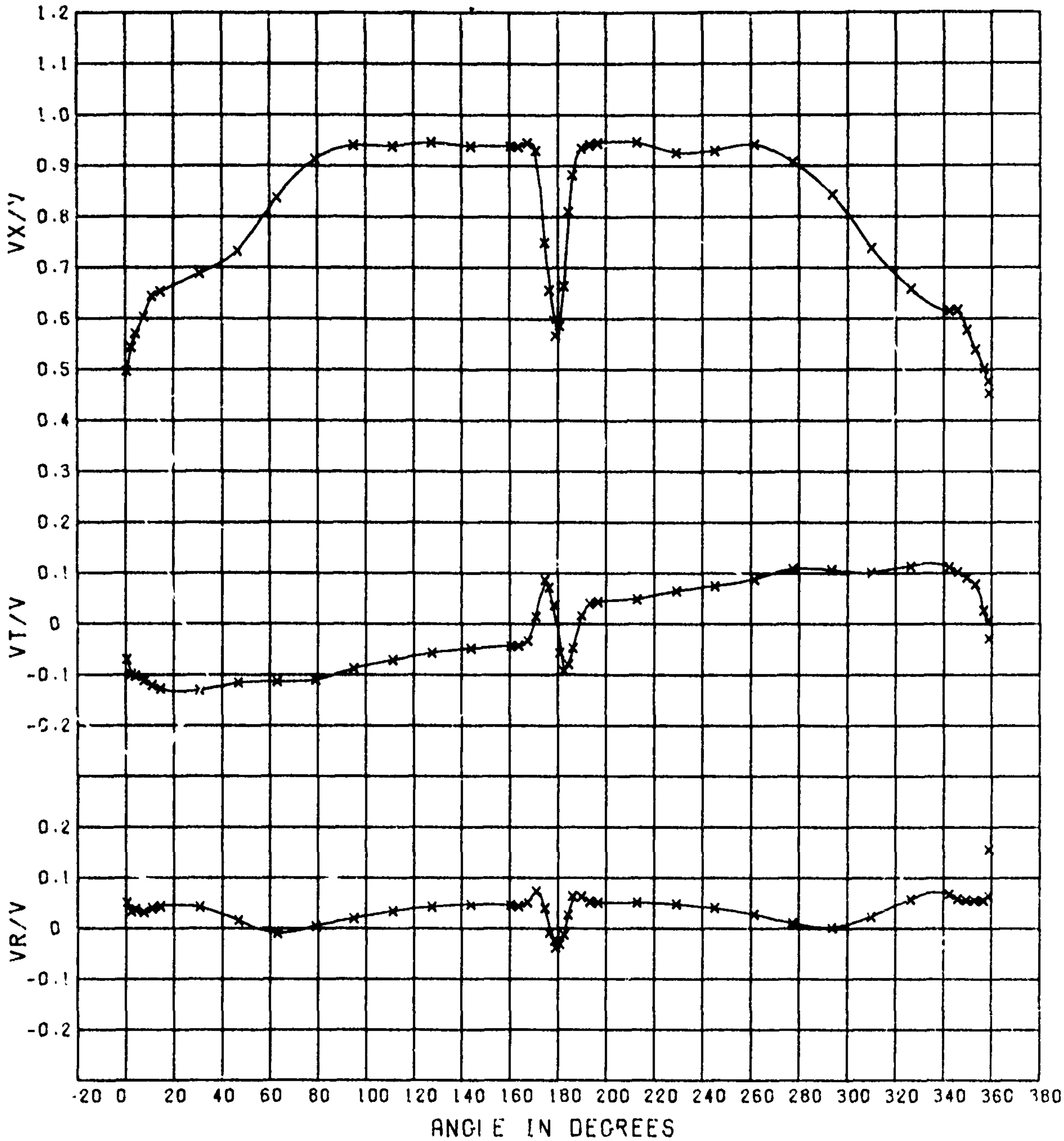


Figure C4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 3
Radius Ratio = 1.107

Fin Configuration 1 (Navy)
Displacement 17,270 tons (17 550 metric tons)

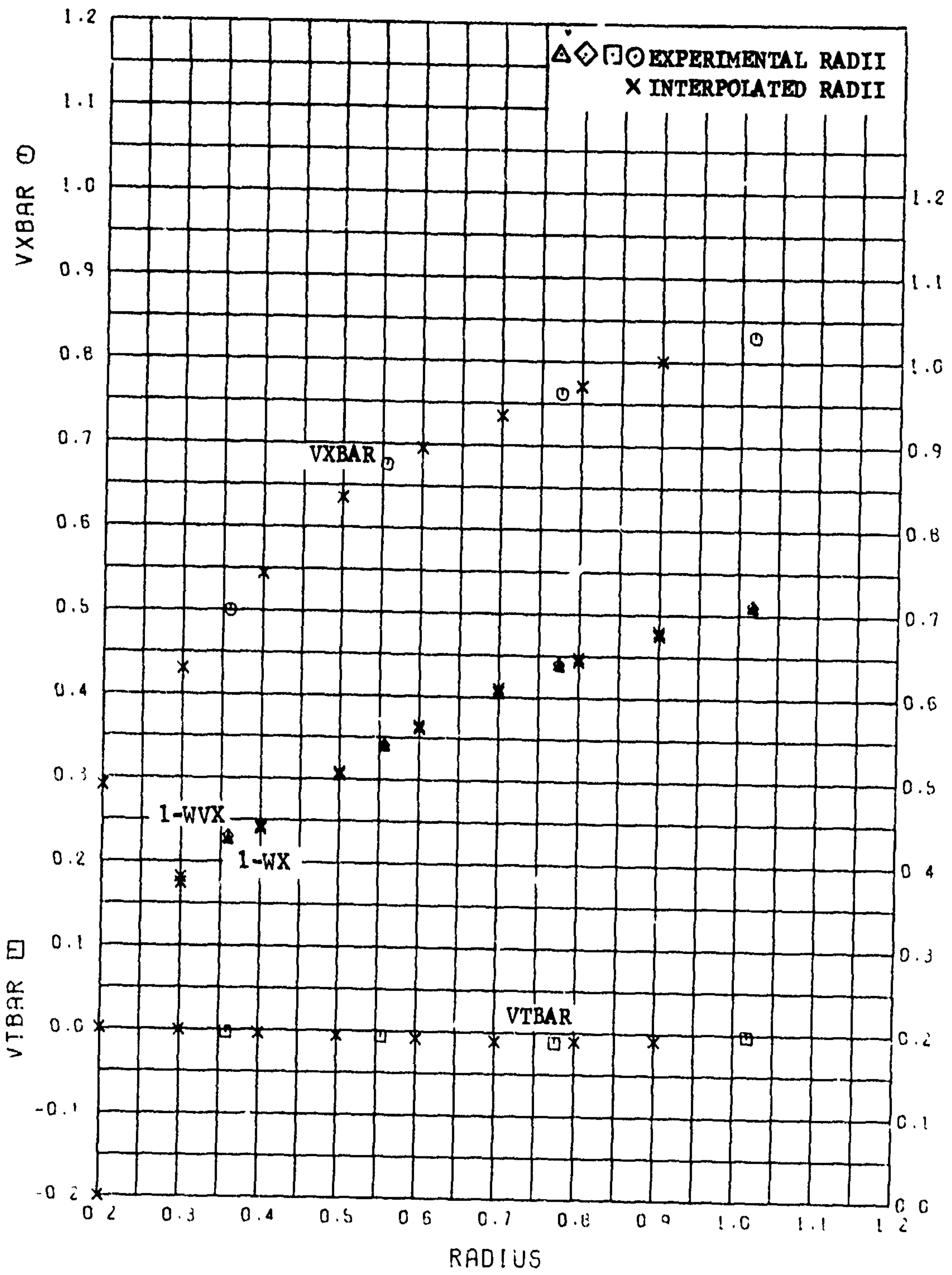


Figure C5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 3

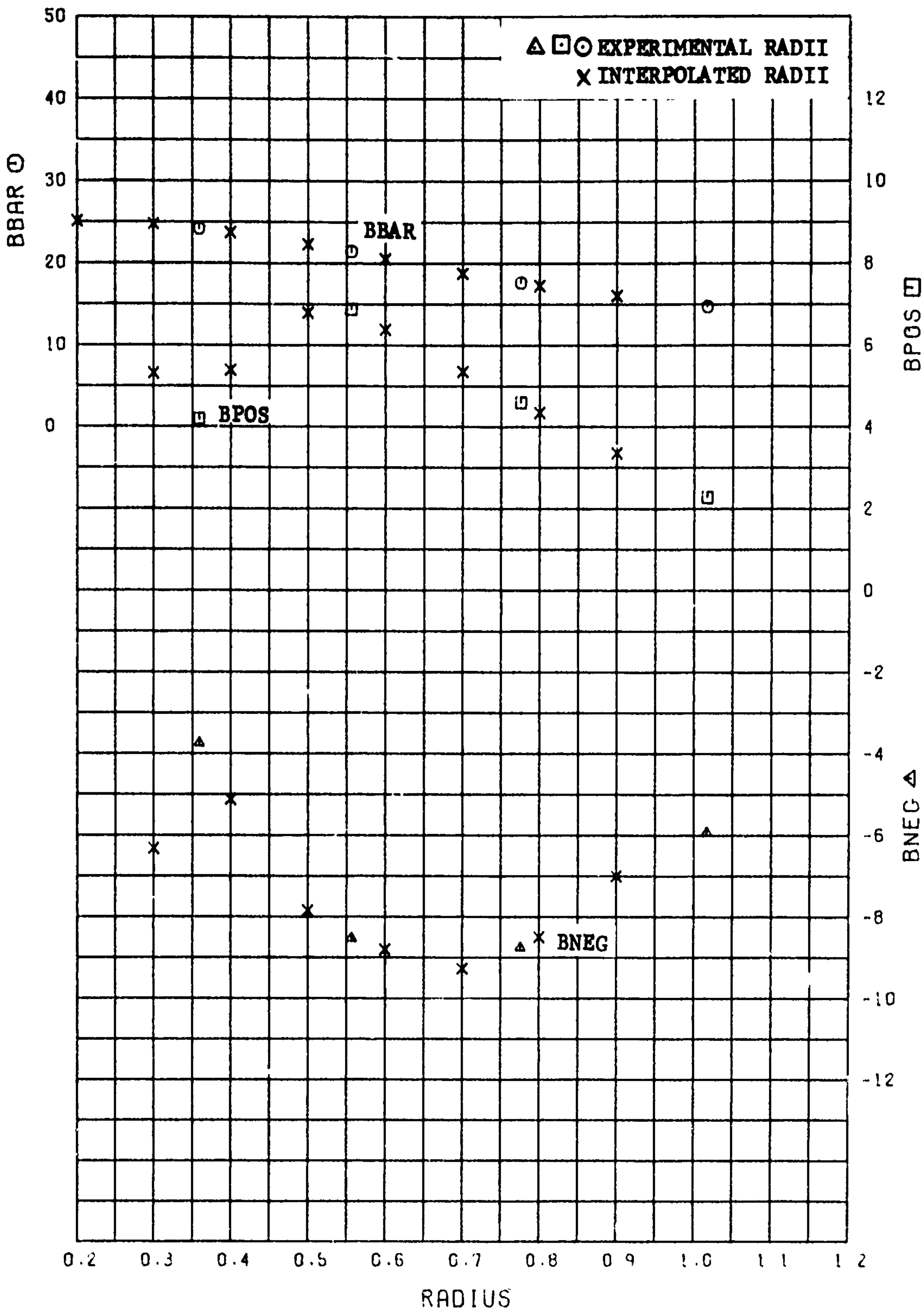


Figure C6 - Radial Distribution o' the Mean Advance Angel and the Maximum Variations of the Advance Angle for Experiment 3

Table C1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 3 with Fin Configuration 1

RADIUS =	.359	.556	.775	1.017	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.500	.675	.757	.830	.291	.430	.544	.635	.695	.735	.770	.801
VTBAR =	-.003	-.007	-.012	-.003	.001	-.001	-.004	-.006	-.009	-.011	-.011	-.009
VRBAR =	.071	.052	.066	.033	.109	.083	.064	.054	.058	.065	.065	.055
1-WVX =	.425	.537	.636	.707	0.000	.374	.440	.505	.561	.606	.643	.675
1-WX =	.431	.540	.640	.711	0.000	.381	.443	.509	.564	.610	.647	.679
BBAR =	24 18	21.41	17.62	14.71	25.05	24.73	23.69	22.29	20.51	18.75	17.28	16.01
BPOS =	4.19	6.88	4.60	2.28	21.04	5.31	5.39	6.79	6.38	5.35	4.35	3.35
THETA =	117.50	122.50	112.50	95.00	167.50	212.50	117.50	120.00	120.00	115.00	112.50	112.50
BNEG =	-3.75	-8.54	-8.76	-5.94	-21.05	-6.33	-5.12	-7.85	-8.81	-9.28	-8.50	-7.00
THETA =	180.00	177.50	180.00	357.50	82.50	80.00	180 00	175.00	177.50	182.50	180.00	180.00

VXBAR	IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR	IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR	IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX	IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX	IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR	IS MEAN ANGLE OF ADVANCE.
BPOS	IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG	IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA	IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	3.75 ft by the stern (1.143 m)
Displacement	17,270 tons (17 550 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table C2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 3 with Fin Configuration 1

Experimential Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.0475	-.0162	.0486	-.0276	.0027	-.0007	.0100	-.0052
RADIUS = .556 AMPLITUDE =	-.0803	-.1551	.0873	-.0462	.0286	-.0238	.0031	-.0099
RADIUS = .775 AMPLITUDE =	-.1212	-.1553	.0548	-.0574	.0485	-.0486	.0257	-.0378
RADIUS = 1.017 AMPLITUDE =	-.1445	-.1009	-.0006	-.0128	.0179	-.0277	.0087	-.0253

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.0239	.1917	-.0296	-.0067	-.0238	.0185	.0344	-.0157
RADIUS = .300 AMPLITUDE =	-.0385	.0509	.0244	-.0205	-.0065	.0064	.0171	-.0076
RADIUS = .400 AMPLITUDE =	-.0540	-.0559	.0619	-.0322	.0087	-.0056	.0064	-.0046
RADIUS = .500 AMPLITUDE =	-.0706	-.1290	.0828	-.0418	.0220	-.0173	.0024	-.0066
RADIUS = .600 AMPLITUDE =	-.0900	-.1589	.0821	-.0524	.0363	-.0321	.0105	-.0185
RADIUS = .700 AMPLITUDE =	-.1093	-.1606	.0678	-.0591	.0468	-.0448	.0220	-.0324
RADIUS = .800 AMPLITUDE =	-.1247	-.1524	.0501	-.0556	.0479	-.0488	.0260	-.0386
RADIUS = .900 AMPLITUDE =	-.1361	-.1344	.0288	-.0418	.0396	-.0442	.0224	-.0371

Table C3 - Harmonic Analysis for the Tangential Velocity Component Ratios for Experiment 3 with Fin Configuration 1

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.0624	.0018	.0522	-.0148	.0086	-.0073	.0052	-.0063
RADIUS = .556 AMPLITUDE =	-.0686	-.0112	.0335	-.0124	.0154	-.0103	.0035	-.0063
RADIUS = .775 AMPLITUDE =	-.1134	-.0254	.0021	-.0098	.0076	-.0181	.0091	-.0145
RADIUS = 1.017 AMPLITUDE =	-.1128	-.0367	-.0268	-.0150	-.0171	-.0139	-.0060	-.0074

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.2309	.0123	.0608	-.0168	-.0062	-.0077	.0114	-.0113
RADIUS = .300 AMPLITUDE =	.1164	.0057	.0561	-.0155	.0041	-.0072	.0070	-.0076
RADIUS = .400 AMPLITUDE =	.0281	-.0009	.0490	-.0143	.0111	-.0076	.0043	-.0057
RADIUS = .500 AMPLITUDE =	-.0401	-.0075	.0357	-.0131	.0143	-.0090	.0033	-.0056
RADIUS = .600 AMPLITUDE =	-.0811	-.0143	.0268	-.0113	.0149	-.0127	.0061	-.0091
RADIUS = .700 AMPLITUDE =	-.1029	-.0210	.0123	-.0099	.0118	-.0166	.0092	-.0133
RADIUS = .800 AMPLITUDE =	-.1158	-.0268	-.0012	-.0100	.0059	-.0183	.0086	-.0146
RADIUS = .900 AMPLITUDE =	-.1197	-.0319	-.0136	-.0115	-.0030	-.0176	.0041	-.0130

Table C4 - Input Data for Wake Survey Analysis for Experiment 3 with Fin Configuration 1

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
.5	.487	.017	.163
2.4	.484	.015	.164
4.2	.485	.017	.163
5.9	.485	.024	.160
9.6	.469	.030	.155
13.0	.474	.034	.161
16.6	.479	.046	.124
32.5	.482	.080	.082
48.8	.480	.069	.053
65.0	.476	.048	.032
81.3	.475	.016	.044
97.4	.536	.015	.075
113.9	.615	.025	.092
130.1	.614	.053	.091
146.4	.595	.074	.063
162.5	.529	.088	.009
166.3	.509	.084	.009
169.8	.519	.083	.008
173.5	.473	.068	-.008
177.1	.453	.044	-.014
178.9	.418	.029	-.012
180.7	.429	.015	-.022
182.5	.413	-.013	-.015
184.3	.396	-.037	-.014
186.1	.423	-.052	-.004
189.8	.438	-.065	-.003
193.3	.451	-.093	.006
197.0	.474	-.101	.010
212.9	.546	-.089	.059
229.1	.559	-.067	.097
245.3	.558	-.031	.098
261.7	.507	-.011	.081
277.7	.436	-.030	.046
294.3	.433	-.064	.044
310.4	.441	.078	.056
326.6	.435	-.087	.104
342.7	.440	-.052	.149
346.4	.449	-.036	.159
349.9	.435	-.017	.165
353.6	.452	-.002	.171
355.5	.441	-.009	.169
357.2	.446	-.002	.165
357.2	.439	-.008	.186
358.9	.490	.007	.166

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
.4	.468	-.024	.167
2.2	.473	-.016	.161
4.0	.466	-.033	.150
7.5	.506	-.028	.144
11.0	.529	-.022	.120
14.6	.543	-.014	.105
30.9	.562	-.021	.050
46.9	.616	-.063	.029
63.0	.687	-.091	.018
79.1	.788	-.096	.021
95.2	.842	-.094	.032
111.5	.875	-.084	.054
127.7	.896	-.054	.077
143.9	.820	-.006	.090
160.3	.577	.048	.026
163.7	.514	.055	-.015
167.4	.458	.058	-.056
170.9	.432	.051	-.067
174.6	.407	.031	-.080
176.3	.396	.019	-.095
178.1	.399	.012	-.090
178.9	.408	.007	-.093
180.6	.415	.000	-.088
182.4	.414	-.014	-.088
184.3	.420	-.037	-.077
186.0	.433	-.041	-.067
186.1	.437	-.046	-.071
189.7	.477	-.057	-.045
193.2	.532	-.053	-.025
196.8	.606	-.055	.009
212.9	.753	-.007	.092
229.1	.835	.046	.086
245.2	.844	.071	.063
261.4	.813	.081	.047
277.5	.723	.084	.032
293.8	.660	.065	.032
310.1	.560	.039	.038
326.3	.536	-.000	.064
342.5	.509	.003	.129
346.0	.502	.007	.151
349.6	.491	.000	.153
353.1	.460	-.015	.160
356.8	.466	-.019	.171
358.7	.460	-.035	.161

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
.5	.444	-.032	.146
2.4	.450	-.047	.149
4.2	.466	-.061	.139
5.9	.493	-.070	.132
9.6	.535	-.070	.115
13.0	.550	-.063	.105
16.6	.567	-.070	.099
32.5	.612	-.094	.060
48.9	.692	-.118	.031
65.0	.808	-.129	.029
81.3	.879	-.129	.027
97.4	.921	-.116	.048
113.9	.947	-.094	.064
130.1	.932	-.065	.031
146.4	.932	-.074	.096
155.0	.905	-.040	.110
162.5	.862	.009	.115
166.3	.758	.033	.104
169.8	.656	.055	.079
173.5	.528	.060	.020
177.1	.439	.052	-.035
178.9	.384	.045	-.037
180.7	.364	.023	-.051
182.5	.330	-.027	-.049
184.3	.389	-.049	-.052

Table C4 - Continued

186.1	.438	-.060	-.038
189.8	.535	-.063	.024
193.3	.655	-.069	.079
197.0	.756	-.045	.108
212.9	.910	.043	.109
229.1	.923	.060	.085
245.3	.907	.072	.073
261.7	.887	.096	.055
277.7	.841	.108	.032
294.3	.769	.118	.027
310.4	.668	.091	.036
326.6	.585	.068	.064
342.7	.576	.045	.103
346.4	.556	.040	.114
349.9	.510	.045	.130
353.6	.491	.028	.134
355.5	.468	.023	.142
357.2	.464	.009	.148
357.2	.478	.017	.150
358.9	.433	-.037	.152

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
359.0	.452	.007	.156
.4	.497	-.071	.050
2.2	.544	-.099	.033
4.0	.570	-.103	.037
7.5	.603	-.112	.032
11.0	.643	-.121	.039
14.6	.652	-.128	.043
30.9	.688	-.131	.042
46.9	.712	-.117	.015
63.0	.837	-.114	-.011
79.1	.913	-.111	.004
95.2	.940	-.088	.019
111.5	.938	-.072	.034
127.7	.946	-.058	.042
143.9	.938	-.049	.047
150.3	.935	-.044	.046
163.7	.937	-.043	.044
167.4	.945	-.034	.051
170.9	.929	.014	.073
174.6	.749	.087	.040
176.3	.635	.072	-.009
178.1	.585	.029	-.039
178.8	.609	.041	-.010
178.9	.567	.037	-.039
180.6	.586	-.053	-.051
182.4	.663	-.093	-.013
184.2	.835	-.072	.032
184.3	.784	-.088	.020
186.0	.895	-.041	.065
186.0	.870	-.055	.062
189.7	.934	.016	.062
193.2	.941	.039	.053
196.8	.944	.043	.051
212.9	.946	.048	.051
229.1	.926	.065	.048
245.2	.929	.074	.040
261.4	.942	.088	.028
277.5	.907	.108	.010
293.8	.844	.106	.001
310.1	.737	.100	.023
326.3	.659	.113	.057
342.5	.615	.112	.067
346.0	.617	.102	.058
349.6	.578	.091	.055
353.1	.539	.078	.055
356.8	.502	.026	.055
358.7	.477	-.029	.064
360.4	.497	-.071	.050

Tube 5 r/R = 1.178
out of water

APPENDIX D

EXPERIMENT 4

FIN CONFIGURATION 3 (NAVY)

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

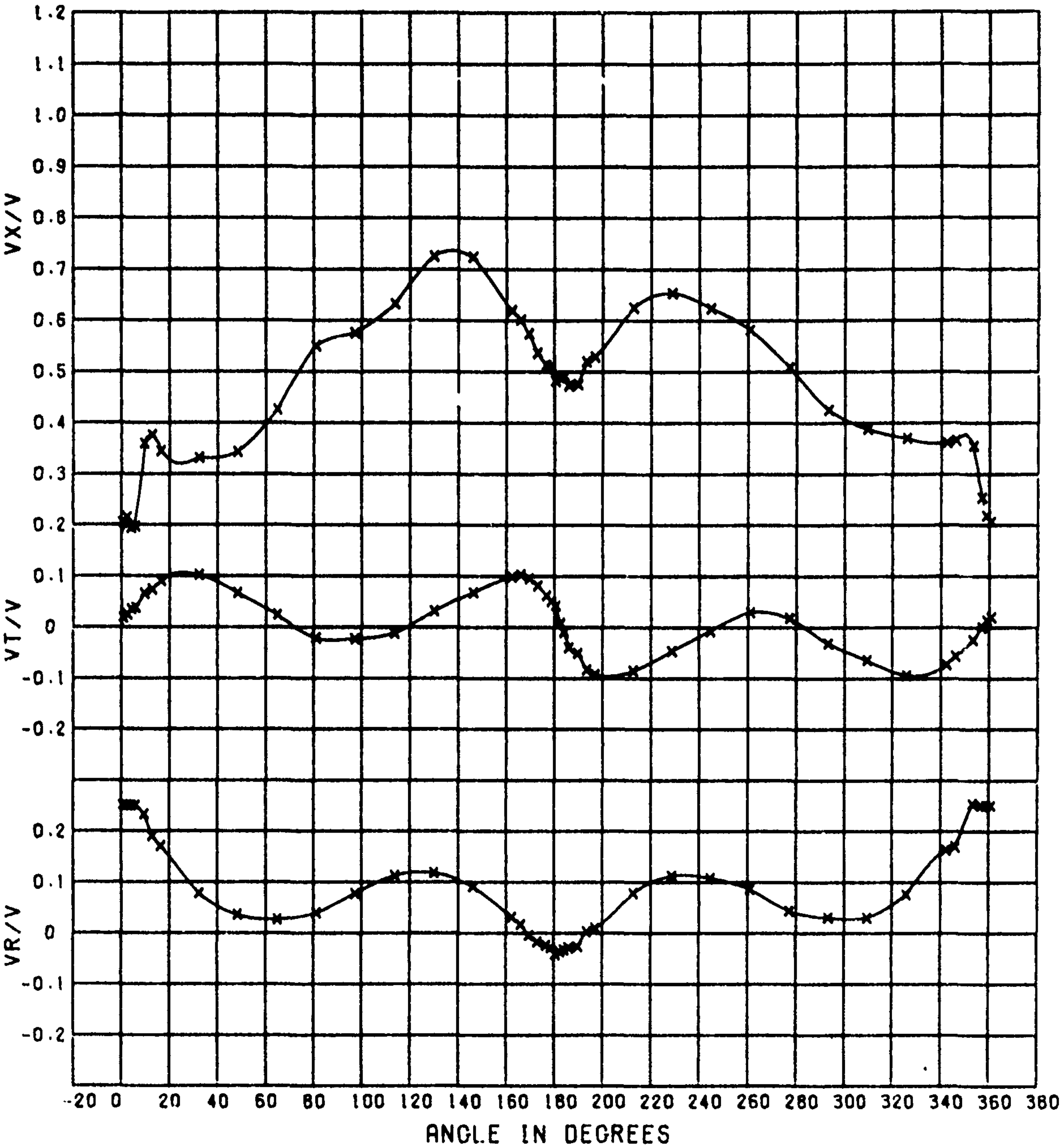


Figure D1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 4
Radius Ratio = 0.359

Fin Configuration 3 (Navy)
Displacement 26,390 tons (26 810 metric tons)

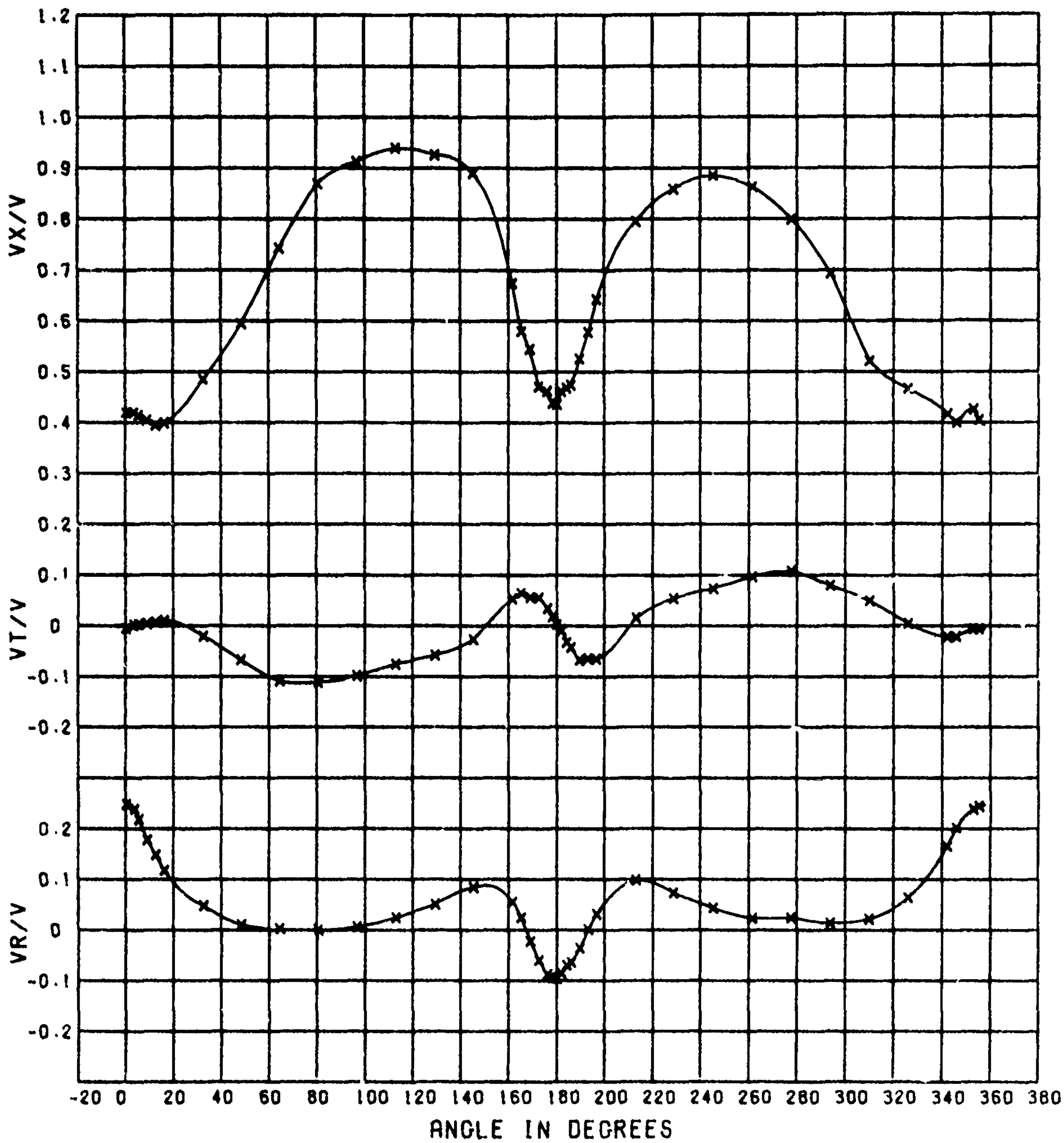


Figure D2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 4
Radius Ratio = 0.556

Fin Configuration 3 (Navy)
Displacement 26,390 tons (26 810 metric tons)

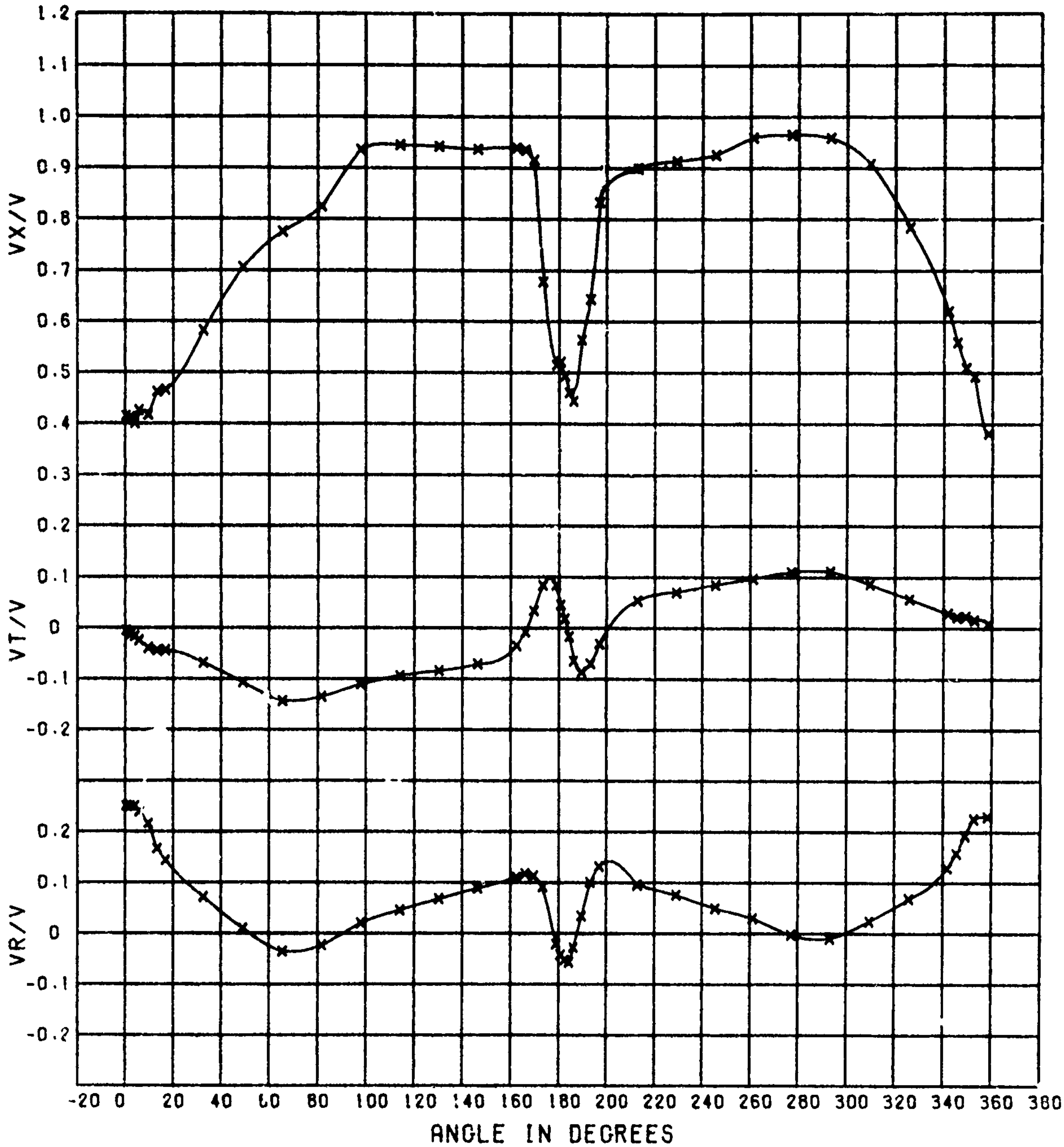


Figure D3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 4
Radius Ratio = 0.775

Fin Configuration 3 (Navy)
Displacement 26,390 tons (26 810 metric tons)

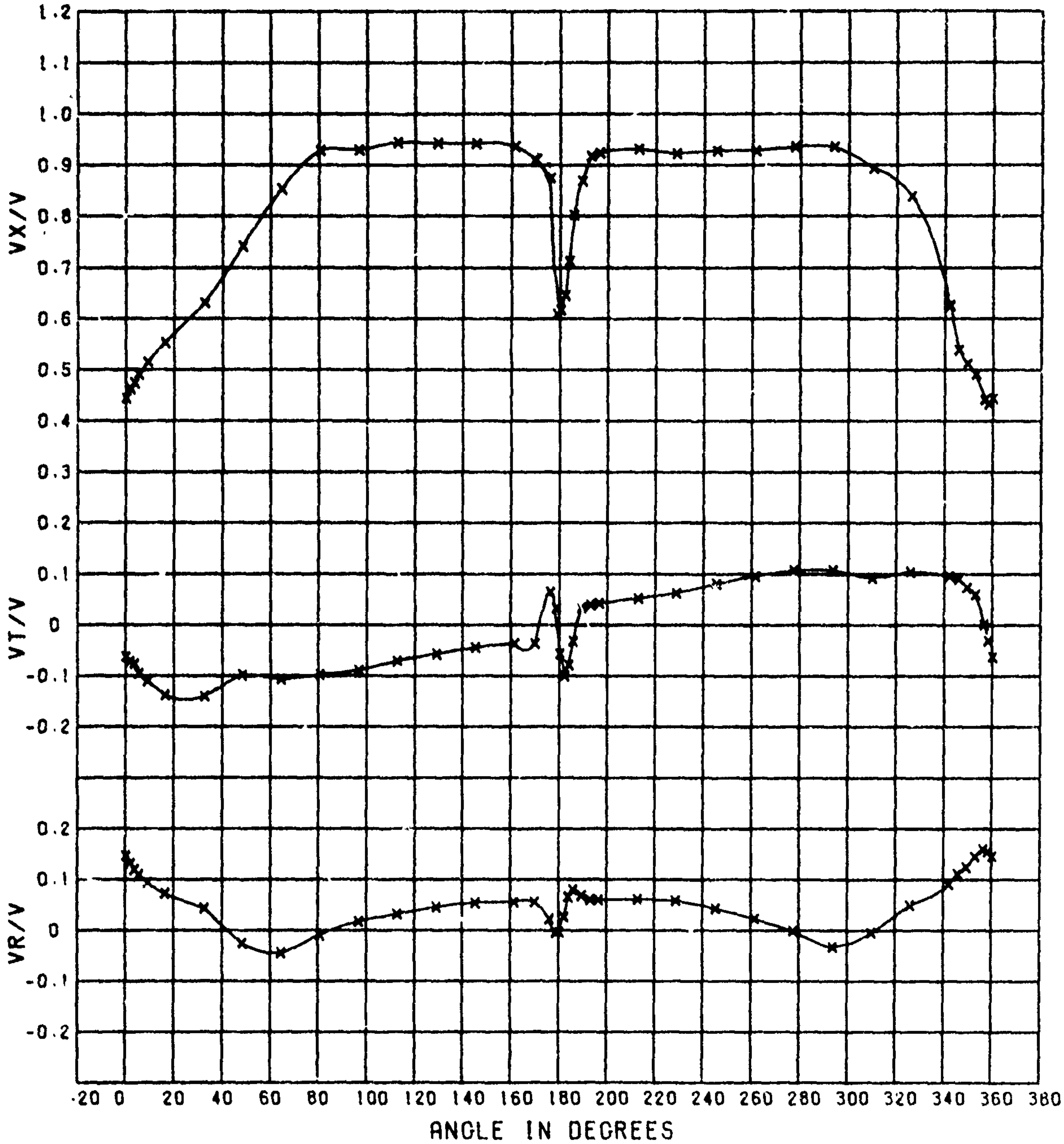


Figure D4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 4
Radius Ratio = 1.107

Fin Configuration 3 (Navy)
Displacement 26,390 tons (26 810 metric tons)

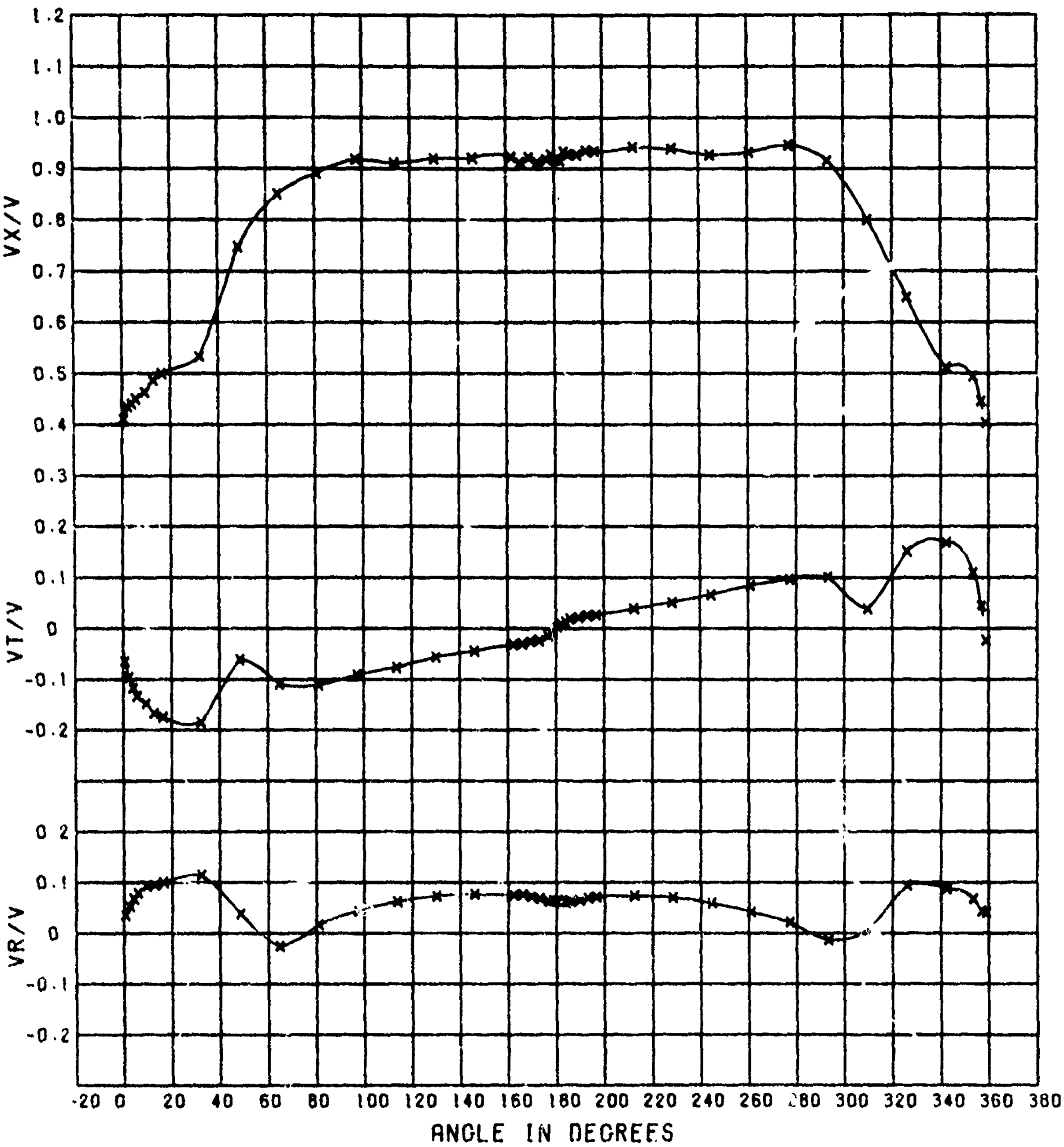


Figure D5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 4
Radius Ratio = 1.178

Fin Configuration 3 (Navy)
Displacement 26,390 tons (26 810 metric tons)

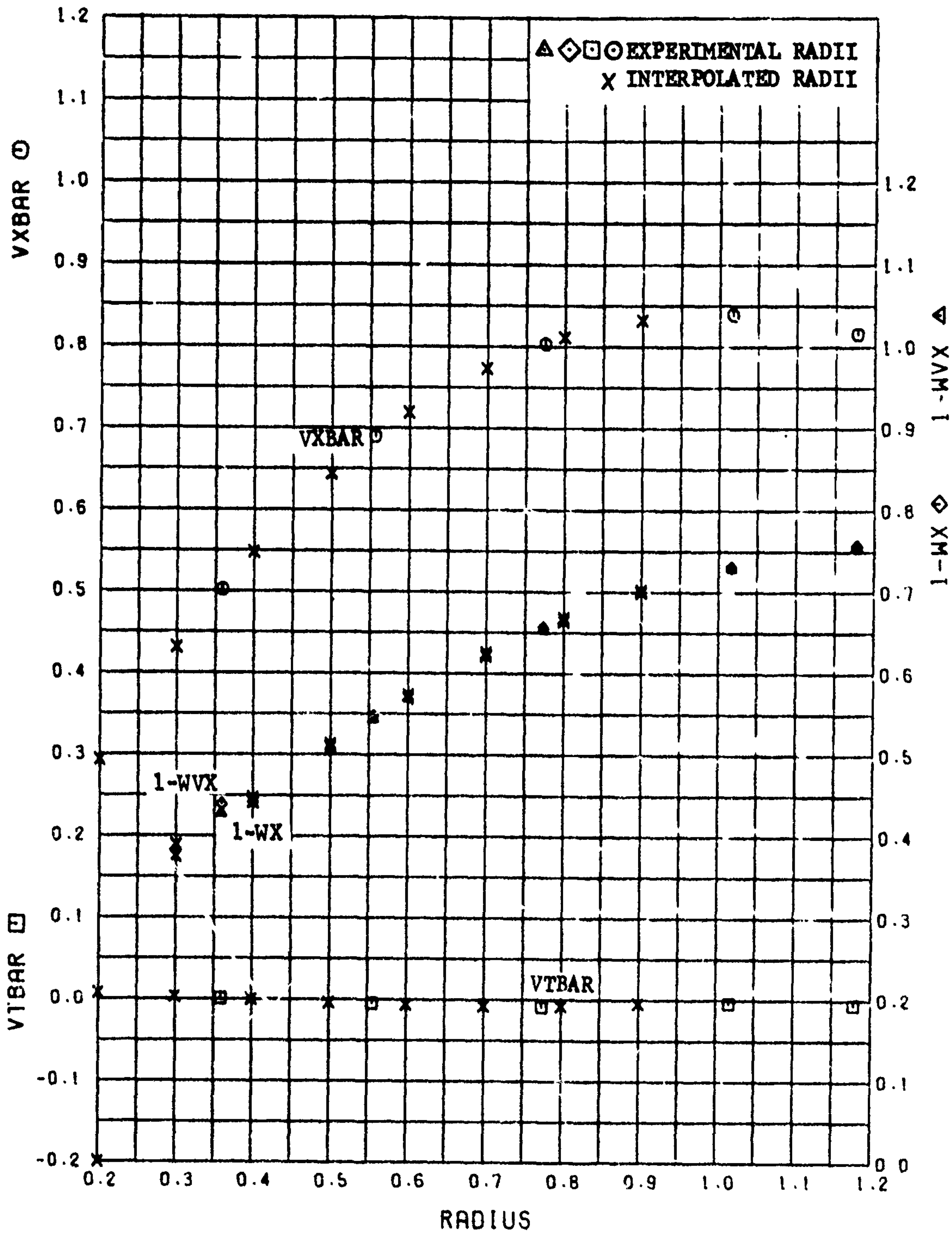


Figure D6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 4

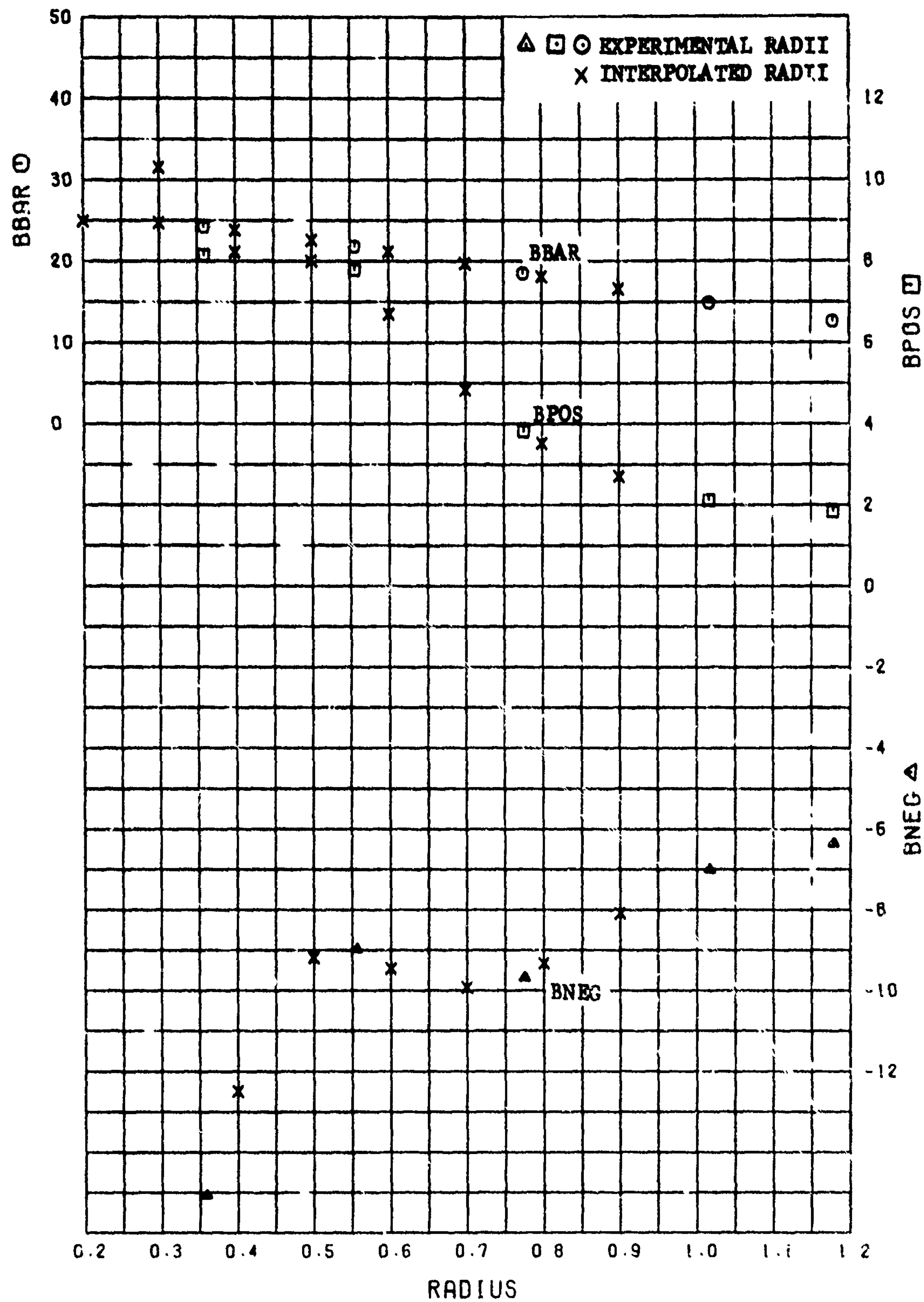


Figure D7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 4

Table D1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 4 with Fin Configuration 3

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.502	.690	.803	.839	.816	.293	.431	.548	.644	.719	.773	.811	.832
VTBAR =	.001	-.005	-.009	-.004	-.006	.007	.003	-.000	-.004	-.006	-.008	-.008	-.005
VRBAR =	.079	.050	.061	.035	.054	.129	.095	.070	.055	.055	.061	.055	.039
1-WVX =	.427	.543	.653	.729	.755	0.000	.375	.441	.509	.569	.621	.664	.699
1-WX =	.439	.547	.656	.731	.757	0.000	.389	.447	.513	.573	.625	.668	.702
BBAR =	24.20	21.79	18.49	14.87	12.58	24.92	24.70	23.78	22.50	21.12	19.61	18.10	16.58
BPOS =	8.15	7.79	3.81	2.11	1.83	24.67	10.31	8.22	8.00	6.70	4.82	3.52	2.70
THETA =	135.00	112.50	105.00	112.50	97.50	165.00	217.50	132.50	117.50	110.00	105.00	107.50	112.50
BNEG =	-15.07	-8.98	-9 69	-7.01	-6.36	-39.26	-20.69	-12.49	-9.19	-9.46	-9.92	-9.33	-8.09
THETA =	0.00	12.50	357.50	357.50	0.00	0.00	0.00	0.00	357.50	357.50	357.50	357.50	357.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table D2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 4 with Fin Configuration 3

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1637	-.0606	.0500	-.0257	.0160	-.0213	-.0096	-.0059
RADIUS = .556 AMPLITUDE =	-.1528	-.1964	.0695	-.0319	.0445	-.0244	.0133	-.0118
RADIUS = .775 AMPLITUDE =	-.1290	-.1628	-.0078	-.0699	.0199	-.0470	.0340	-.0336
RADIUS = 1.017 AMPLITUDE =	-.1368	-.1216	-.0404	-.0426	.0010	-.0281	.0030	-.0211
RADIUS = 1.178 AMPLITUDE =	-.1912	-.1218	-.0529	-.0095	.0109	.0053	.0035	-.0007

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.1653	.1637	-.0271	-.0400	-.0420	-.0306	-.0312	-.0106
RADIUS = .300 AMPLITUDE =	-.1651	.0106	.0278	-.0290	-.0019	-.0235	-.0173	-.0067
RADIUS = .400 AMPLITUDE =	-.1623	-.1018	.0610	-.0248	.0259	-.0206	-.0045	-.0061
RADIUS = .500 AMPLITUDE =	-.1569	-.1738	.0725	-.0275	.0413	-.0219	.0072	-.0088
RADIUS = .600 AMPLITUDE =	-.1457	-.1900	.0503	-.0443	.0390	-.0320	.0212	-.0187
RADIUS = .700 AMPLITUDE =	-.1339	-.1747	.0135	-.0636	.0275	-.0435	.0322	-.0297
RADIUS = .800 AMPLITUDE =	-.1257	-.1563	-.0120	-.0683	.0161	-.0468	.0291	-.0333
RADIUS = .900 AMPLITUDE =	-.1219	-.1353	-.0267	-.0592	.0051	-.0420	.0132	-.0299

Table D3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 4 with Fin Configuration 3

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.0370	.0111	.0723	-.0076	.0143	-.0046	.C082	-.0039
RADIUS = .556 AMPLITUDE =	-.0788	-.0083	.0378	-.0029	.0200	-.0124	.0119	-.0070
RADIUS = .775 AMPLITUDE =	-.1139	-.0141	.0061	.0008	.0089	-.0139	.0079	-.0117
RADIUS = 1.017 AMPLITUDE =	-.1107	-.0319	-.0253	-.0158	-.0187	-.0106	-.0067	-.0041
RADIUS = 1.178 AMPLITUDE =	-.1093	-.0407	-.0364	-.0347	-.0393	-.0251	-.0136	.0007

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.1886	.0365	.1041	-.0122	-.0011	.0062	.0002	-.0023
RADIUS = .300 AMPLITUDE =	.0872	.0195	.0836	-.0092	.0097	-.0011	.0057	-.0032
RADIUS = .400 AMPLITUDE =	.0063	.0059	.0646	-.0065	.0168	-.0068	.0095	-.0044
RADIUS = .500 AMPLITUDE =	-.0540	-.0042	.0470	-.0041	.0199	-.0109	.0115	-.0060
RADIUS = .600 AMPLITUDE =	-.0888	-.0087	.0312	-.0008	.0188	-.0131	.0118	-.0088
RADIUS = .700 AMPLITUDE =	-.1059	-.0111	.0166	.0015	.0142	-.0139	.0102	-.0114
RADIUS = .800 AMPLITUDE =	-.1135	-.0162	.0020	-.0002	.0062	-.0121	.0061	-.0109
RADIUS = .900 AMPLITUDE =	-.1121	-.0240	-.0123	-.0060	-.0048	-.0084	-.0003	-.0077

Table D4 - Input Data for Wake Survey Analysis for Experiment 4 with Fin Configuration 3

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
.6	.204	.018	.250
2.3	.215	.024	.250
4.1	.194	.035	.250
5.8	.196	.038	.250
9.5	.359	.066	.232
12.9	.376	.074	.190
16.5	.344	.090	.171
32.3	.331	.101	.077
48.4	.343	.067	.036
64.8	.426	.024	.026
81.0	.550	-.022	.039
97.4	.575	-.023	.077
113.7	.632	-.013	.112
130.0	.725	.031	.118
146.1	.723	.068	.091
162.3	.619	.098	.031
166.1	.601	.103	.016
169.6	.574	.095	-.005
173.2	.536	.081	-.018
176.8	.513	.062	-.025
178.7	.510	.050	-.029
180.5	.482	.042	-.042
182.4	.489	.007	-.036
184.1	.491	-.009	-.033
186.0	.473	-.040	-.029
189.7	.475	-.051	-.027
193.3	.520	-.084	.003
196.9	.529	-.092	.009
212.6	.625	-.086	.078
228.6	.653	-.047	.112
244.7	.624	-.008	.108
260.9	.582	.029	.086
277.2	.508	.018	.043
293.4	.425	-.032	.031
309.7	.388	-.065	.030
326.0	.370	-.094	.076
342.4	.361	-.073	.164
346.1	.366	-.056	.170
353.4	.354	-.025	.253
357.0	.253	-.001	.250
358.9	.218	.013	.250
360.7	.207	.019	.250

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
.2	.419	-.006	.247
3.7	.420	.001	.238
[illegible]	.413	.002	.218
[illegible].2	.404	.004	.177
12.7	.394	.006	.148
16.3	.399	.010	.117
32.6	.484	-.021	.048
48.5	.595	-.068	.010
64.5	.742	-.109	.002
80.6	.869	-.112	-.001
96.7	.912	-.099	.005
112.9	.939	-.076	.024
129.3	.926	-.058	.051
145.4	.889	-.027	.083
161.6	.674	.053	.054
165.3	.579	.064	.024
168.9	.544	.056	-.023
172.5	.470	.055	-.060
176.1	.461	.034	-.088
177.8	.439	.019	-.090
178.7	.437	.015	-.098
179.6	.433	.002	-.096
180.4	.437	.003	-.098
181.5	.458	-.013	-.084
182.3	.465	-.007	-.089
184.1	.468	-.033	-.071
185.9	.474	-.043	-.064
189.5	.525	-.069	-.036
193.2	.578	-.065	.001
196.8	.643	-.066	.031
213.0	.795	.016	.098
228.7	.858	.054	.073
245.4	.885	.073	.043
261.6	.862	.096	.023
277.7	.798	.108	.024
293.9	.693	.079	.014
310.1	.521	.050	.022
326.1	.466	.004	.064
342.2	.417	-.022	.166
345.9	.399	-.022	.202
353.0	.426	-.006	.238
354.9	.405	-.008	.243
355.6	.405	-.004	.245
360.2	.419	-.006	.247

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
.3	.414	-.006	.250
2.2	.411	-.013	.250
4.0	.400	-.017	.250
5.8	.425	-.025	.239
9.5	.416	-.040	.215
13.1	.462	-.045	.166
16.7	.465	-.044	.143
32.6	.573	-.065	.070
32.6	.590	-.073	.072
49.0	.706	-.108	.009
65.5	.775	-.144	-.036
81.5	.916	-.115	-.016
81.7	.733	-.156	-.032
97.9	.935	-.112	.019
114.2	.944	-.094	.045
130.4	.942	-.085	.068
146.4	.937	-.071	.088
162.5	.939	-.035	.110
166.2	.935	-.008	.117
169.7	.916	.034	.113
173.4	.678	.084	.091
178.9	.515	.084	-.021
180.7	.521	.045	-.043
182.5	.493	.018	-.053
184.3	.461	-.017	-.057
186.2	.444	-.065	-.028
189.7	.564	-.087	.035

Table D4 - Continued

193.3	.644	-.070	.101
197.0	.833	-.031	.132
213.0	.900	.054	.096
229.1	.913	.070	.076
245.5	.926	.084	.049
261.1	.959	.097	.030
277.1	.964	.110	-.003
293.3	.959	.111	-.010
309.6	.908	.086	.024
325.8	.784	.057	.068
341.8	.620	.029	.129
345.5	.559	.022	.158
349.1	.509	.023	.193
352.7	.492	.016	.226
358.2	.376	.010	.230
358.7	.386	.006	.230

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
.2	.444	-.063	.146
2.0	.462	-.072	.131
3.7	.474	-.076	.119
5.6	.491	-.095	.109
9.2	.515	-.111	.093
16.3	.553	-.138	.072
32.6	.631	-.141	.043
48.5	.741	-.098	-.026
64.5	.852	-.107	-.045
80.6	.929	-.098	-.010
96.7	.929	-.090	.016
112.9	.944	-.071	.031
129.3	.942	-.058	.045
145.4	.942	-.045	.053
161.6	.937	-.037	.055
170.0	.910	-.037	.055
176.1	.874	.064	.022
178.7	.608	.033	-.005
180.4	.617	-.057	-.004
182.3	.646	-.101	.026
184.1	.712	-.079	.065
185.9	.801	-.033	.080
189.5	.868	.034	.068
193.2	.918	.040	.060
196.8	.923	.042	.060
213.0	.931	.052	.060
228.7	.922	.063	.058
245.4	.927	.080	.043
261.6	.928	.095	.022
277.7	.935	.106	-.002
293.9	.935	.108	-.033
310.1	.893	.092	-.005
326.1	.838	.104	.050
342.2	.626	.096	.091
345.9	.539	.090	.111
349.4	.512	.073	.124
353.0	.491	.060	.145
356.6	.441	.000	.160
358.4	.432	-.032	.155
360.2	.444	-.063	.146

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
.6	.411	-.066	.035
2.3	.435	-.096	.053
4.1	.441	-.118	.068
5.8	.450	-.135	.079
9.5	.463	-.149	.093
12.9	.486	-.168	.095
16.5	.499	-.176	.100
32.3	.533	-.185	.114
48.4	.747	-.062	.038
64.8	.850	-.110	-.026
81.0	.890	-.112	.017
97.4	.918	-.091	.043
113.7	.910	-.077	.061
130.0	.919	-.057	.072
146.1	.920	-.045	.076
162.3	.923	-.032	.075
166.1	.912	-.031	.076
169.6	.921	-.027	.072
173.2	.912	-.025	.068
176.8	.918	-.015	.063
178.7	.927	-.010	.064
180.5	.918	.002	.064
182.4	.916	.007	.062
184.1	.933	.013	.060
186.0	.928	.019	.062
189.7	.927	.022	.065
193.3	.935	.025	.069
196.9	.933	.027	.071
212.6	.942	.038	.073
228.6	.939	.051	.070
244.7	.927	.066	.059
260.9	.932	.084	.041
277.2	.946	.096	.021
293.4	.915	.101	-.014
309.7	.800	.038	.006
326.0	.648	.151	.094
342.4	.510	.169	.087
353.4	.493	.109	.067
357.0	.445	.044	.043
358.9	.408	-.016	.040
358.9	.397	-.033	.039
360.6	.411	-.066	.035

APPENDIX E

EXPERIMENT 5

FIN CONFIGURATION 3 (NAVY)
(leading edge up 2.5°)

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

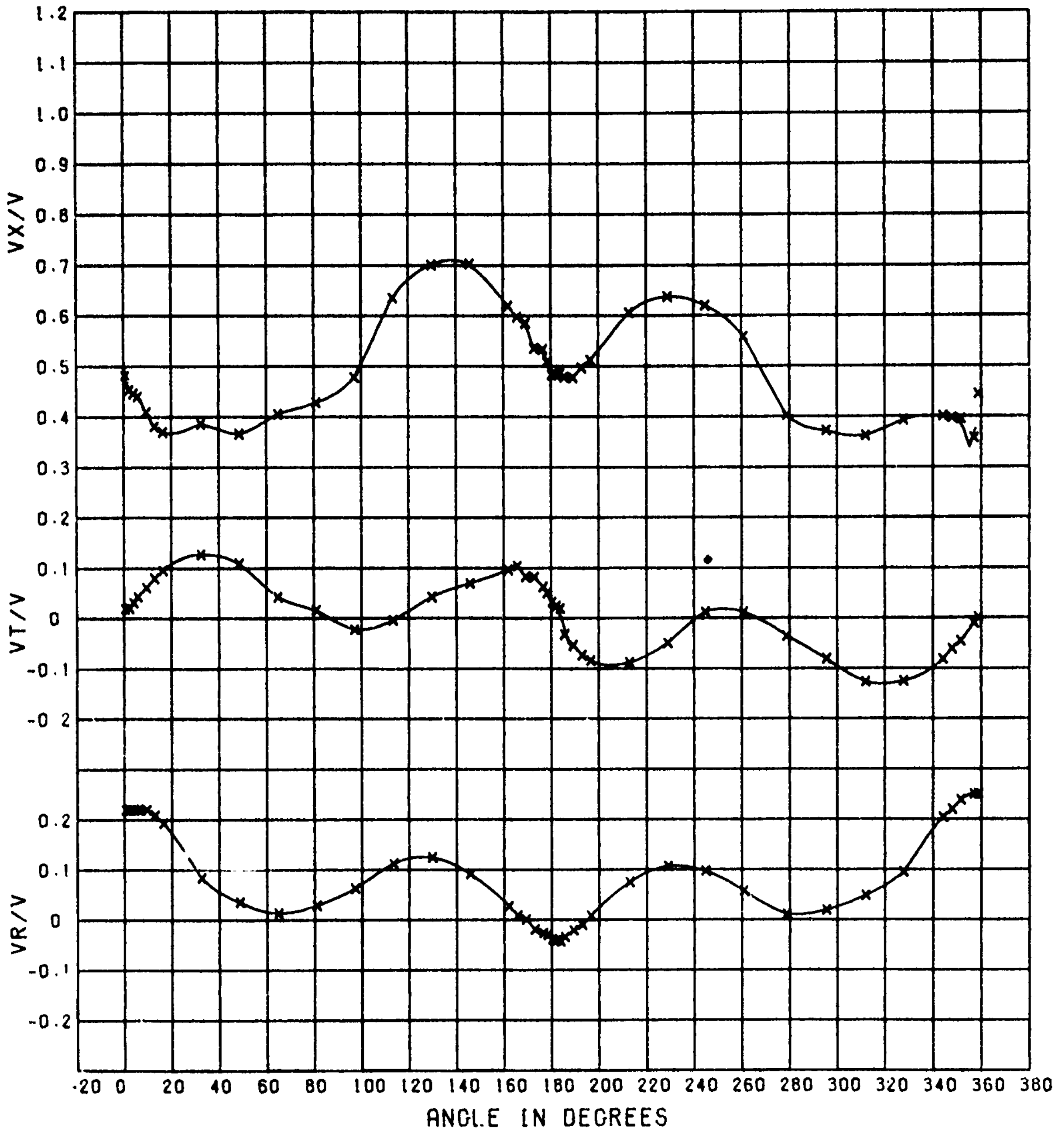


Figure E1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 5
Radius Ratio = 0.359

Fin Configuration	3 (Navy) leading edge up 2.5 degrees
Displacement	26,390 tons (26 810 metric tons)

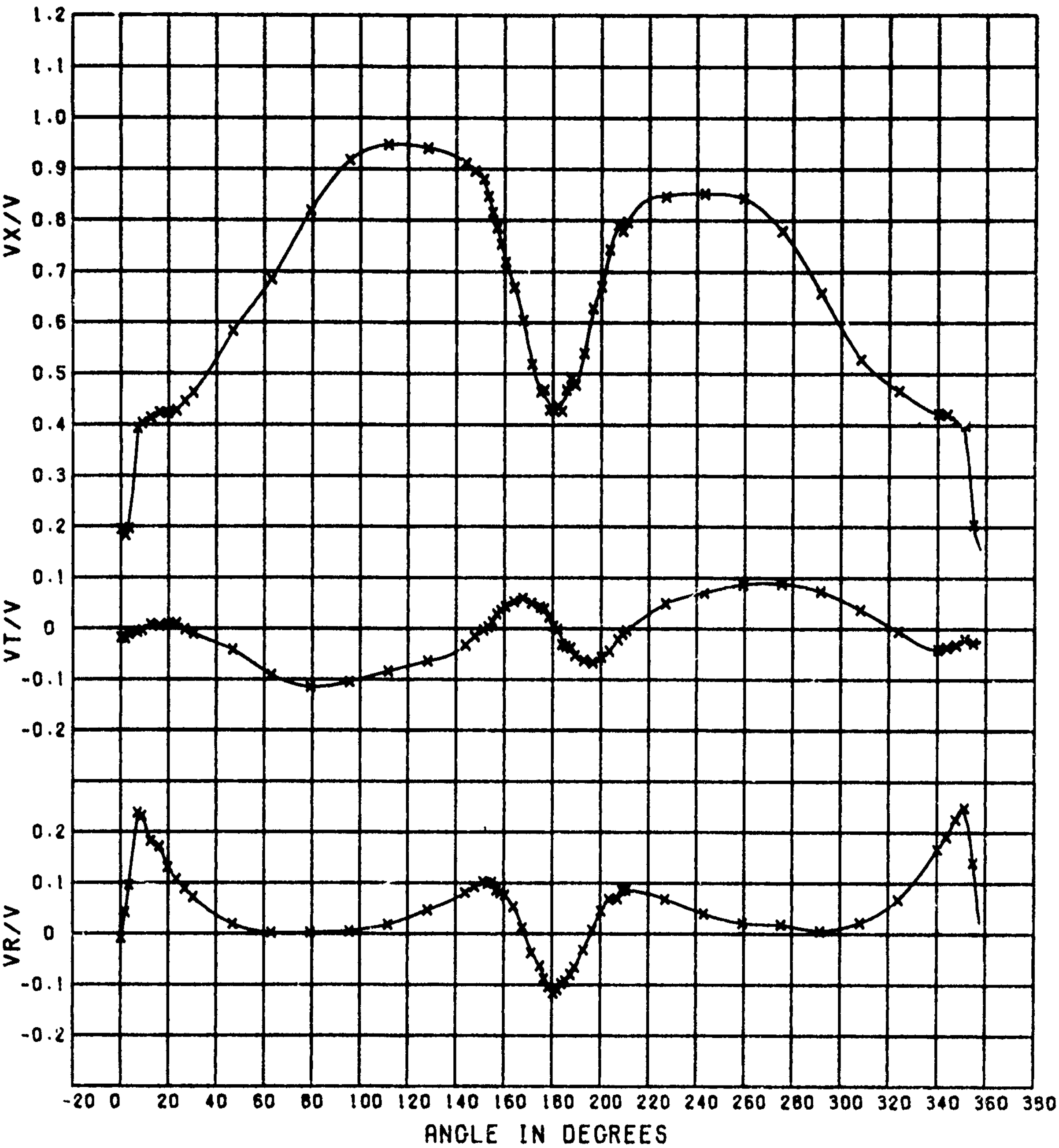


Figure E2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 5
Radius Ratio = 0.556

Fin Configuration 3 (Navy) leading edge up 2.5 degrees
Displacement 26,390 tons (26 810 metric tons)

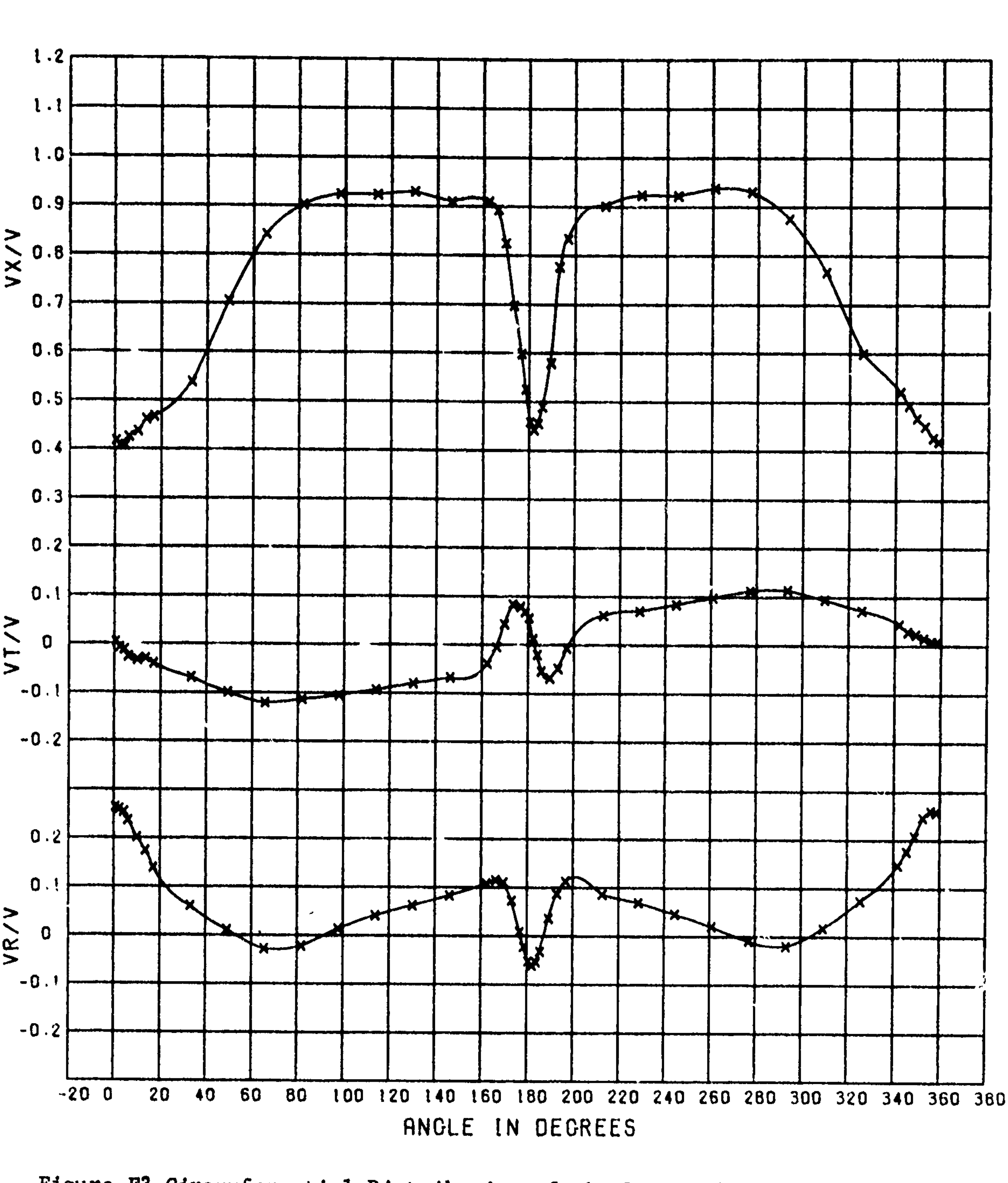


Figure E3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 5
Radius Ratio = 0.775

Fin Configuration 3 (Navy) leading edge up 2.5 degrees
Displacement 26,390 tons (26 810 metric tons)

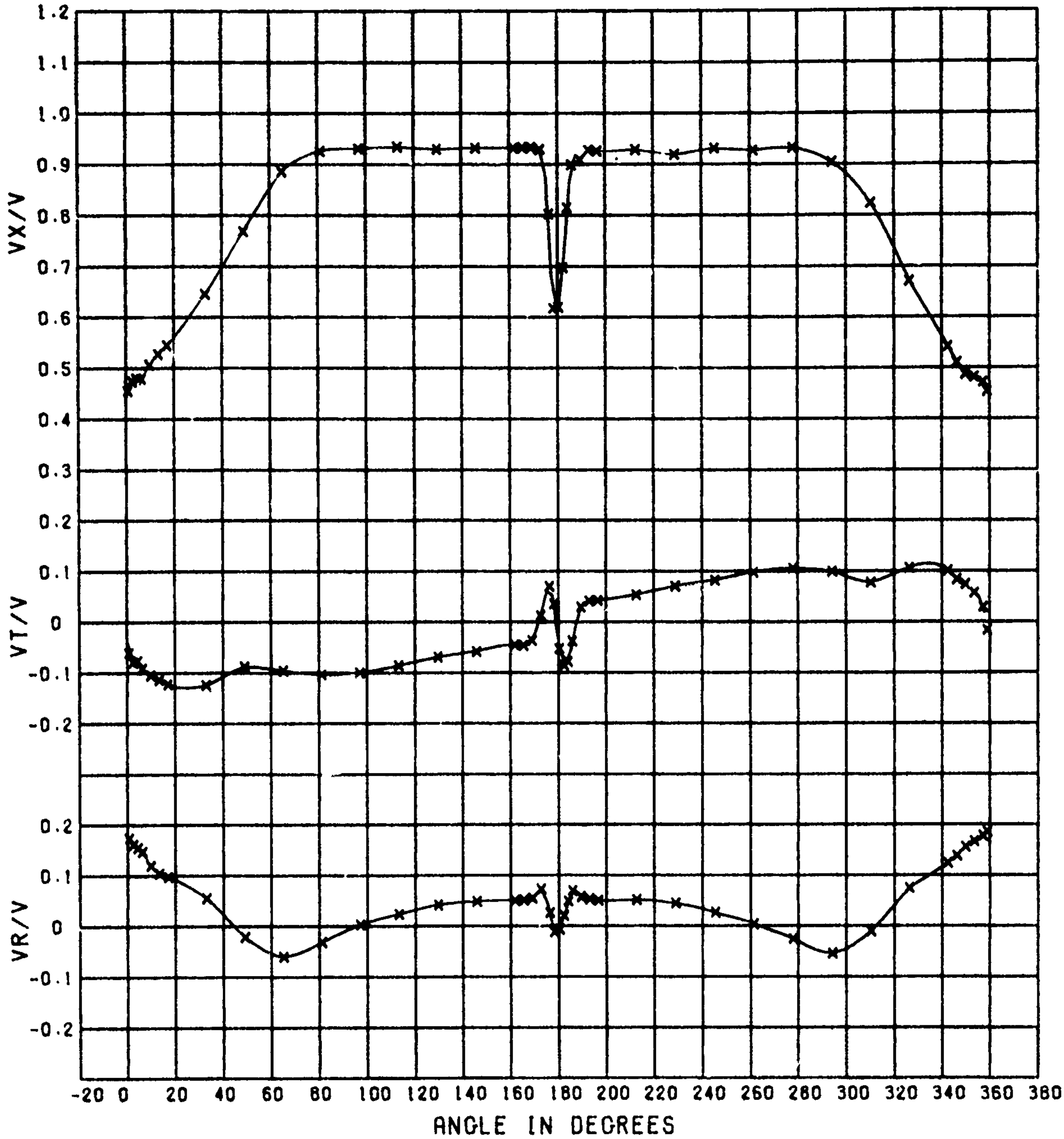


Figure E4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 5
Radius Ratio = 1.107

Fin Configuration 3 (Navy) leading edge up 2.5 degrees
Displacement 26,390 tons (26 810 metric tons)

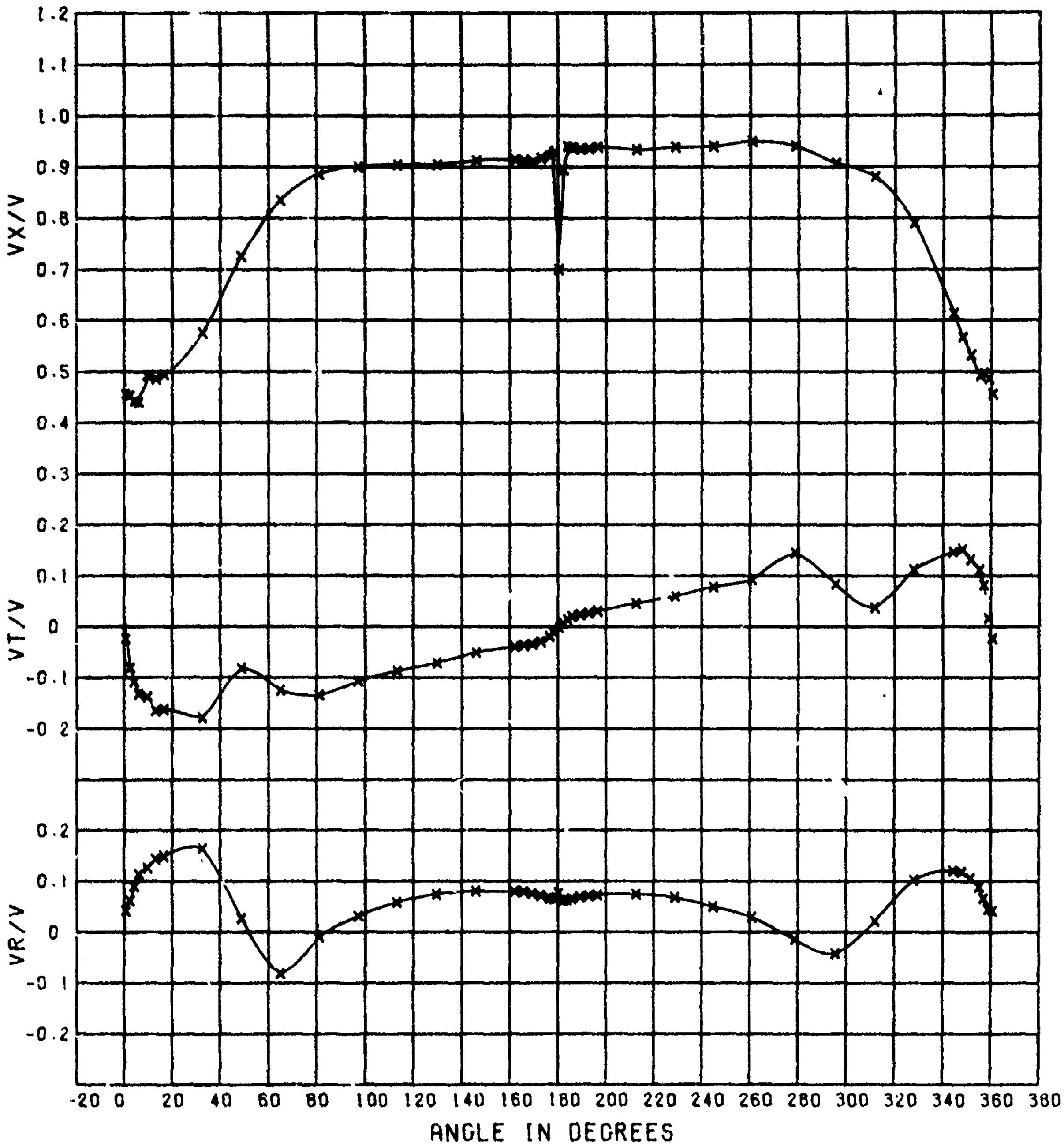


Figure E5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 5
Radius Ratio = 1.178

Fin Configuration 3 (Navy) leading edge up 2.5 degrees
Displacement 26,390 tons (26 810 metric tons)

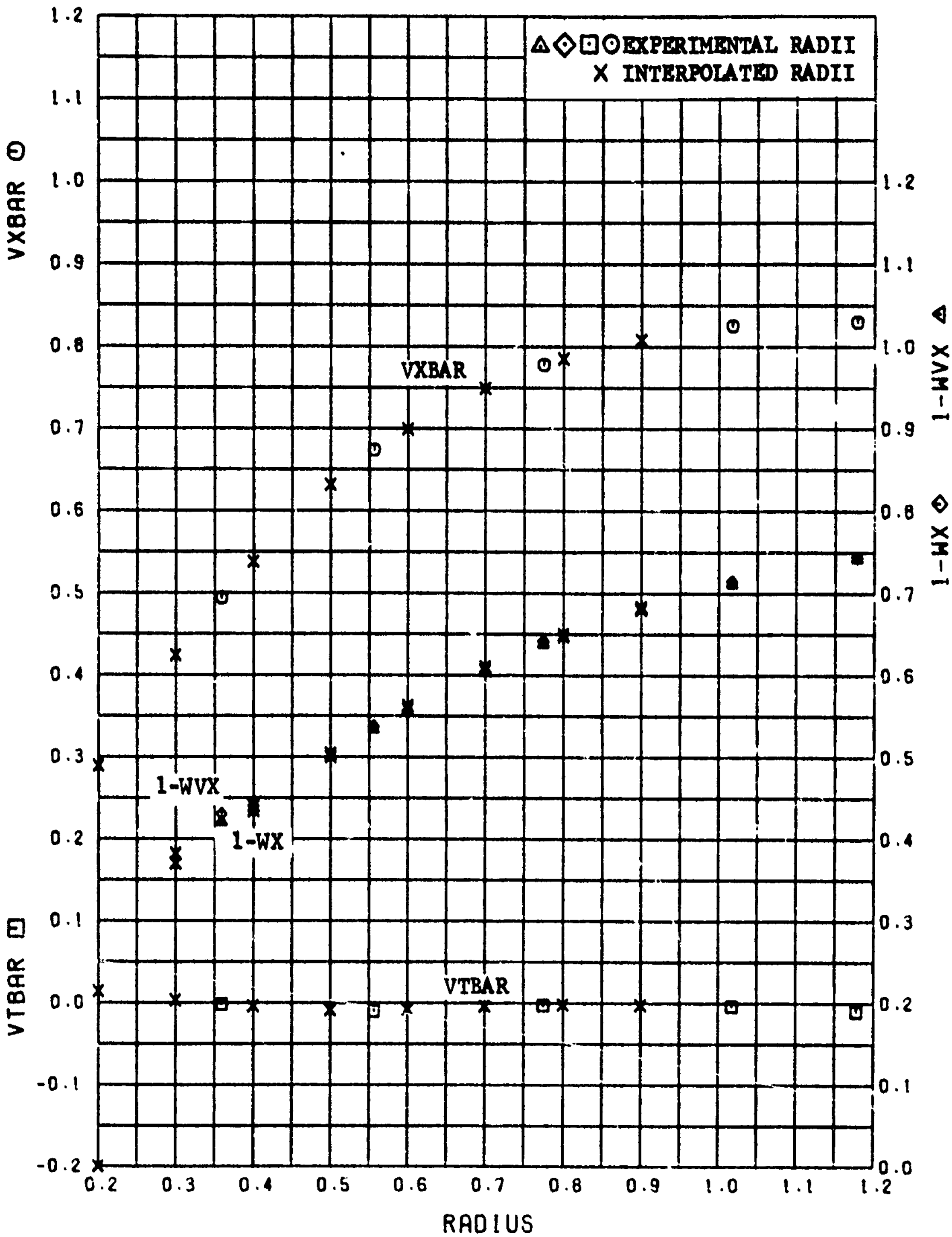


Figure E6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 5

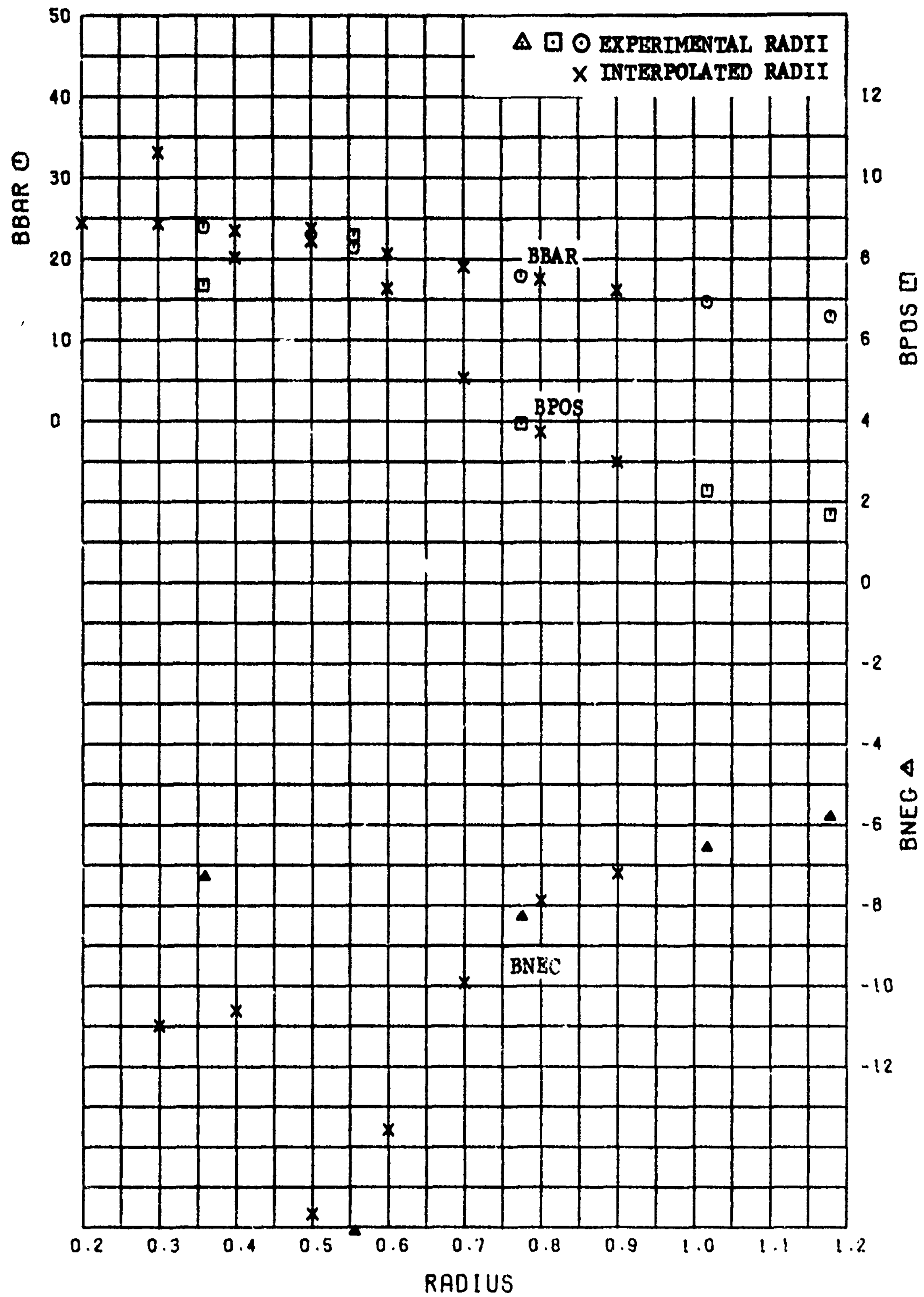


Figure E7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 5

Table E1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 5 with Fin Configuration 3 Leading Edge Up 2.5 Degrees

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.494	.674	.778	.825	.830	.289	.424	.538	.631	.699	.749	.785	.808
VTBAR =	-.002	-.010	-.003	-.004	-.010	.014	.003	-.004	-.009	-.008	-.004	-.002	-.003
VRBAR =	.076	.046	.058	.032	.054	.129	.093	.067	.050	.051	.058	.052	.036
1-WVX =	.420	.533	.637	.711	.742	0.000	.370	.434	.500	.558	.606	.647	.680
1-WX =	.430	.537	.641	.714	.744	0.000	.382	.440	.504	.562	.610	.650	.683
BBAR =	23.89	21.39	17.90	14.64	12.60	24.41	24.36	23.46	22.19	20.62	19.01	17.52	16.12
BPOS =	7.35	8.57	3.93	2.27	1.67	32.20	10.62	8.03	8.76	7.27	5.05	3.73	2.99
THETA =	135.00	110.00	100.00	90.00	177.50	0.00	0.00	125.00	117.50	107.50	102.50	100.00	102.50
BNEG =	-7.30	-16.11	-8.29	-6.58	-5.81	-39.88	-10.99	-10.62	-15.67	-13.58	-9.92	-7.89	-7.21
THETA =	47.50	357.50	2.50	0.00	0.00	95.00	55.00	355.00	357.50	357.50	2.50	2.50	0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	**1.0 ft by the bow (0.305 m)**
Displacement	**26,390 tons (26 810 metric tons)**
Propeller Diameter	**21.0 ft (6.40 m)**
Speed	**20.0 knots**
J_V	**1.01**

Table E2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 5 with Fin Configuration 3 Leading Edge Up 2.5 Degrees

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1348	-.0049	.0754	-.0319	.0086	.0006	.0057	-.0037
RADIUS = .556 AMPLITUDE =	-.1771	-.1956	.0640	-.0527	.0256	-.0472	.0065	-.0229
RADIUS = .775 AMPLITUDE =	-.1549	-.1756	.0004	-.0414	.0439	-.0297	.0277	-.0284
RADIUS = 1.017 AMPLITUDE =	-.1588	-.1282	-.0424	-.0263	.0120	-.0120	.0103	-.0155
RADIUS = 1.178 AMPLITUDE =	-.1578	-.1074	-.0499	-.0225	-.0071	-.0093	.0001	-.0046

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.0576	.0931	.0531	.0062	-.0054	.0829	.0177	.0217
RADIUS = .300 AMPLITUDE =	-.1106	.0907	.0704	-.0200	.0034	.0265	.0088	.0047
RADIUS = .400 AMPLITUDE =	-.1485	-.0609	.0766	-.0386	.0122	-.0143	.0044	-.0088
RADIUS = .500 AMPLITUDE =	-.1711	-.1615	.0717	-.0497	.0208	-.0397	.0045	-.0188
RADIUS = .600 AMPLITUDE =	-.1707	-.1933	.0493	-.0506	.0328	-.0435	.0136	-.0253
RADIUS = .700 AMPLITUDE =	-.1597	-.1849	.0135	-.0455	.0426	-.0355	.0244	-.0283
RADIUS = .800 AMPLITUDE =	-.1556	-.1698	-.0058	-.0394	.0404	-.0271	.0258	-.0272
RADIUS = .900 AMPLITUDE =	-.1577	-.1487	-.0364	-.0323	.0270	-.0185	.0184	-.0223

Table E3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 5 with Fin Configuration 3 Leading Edge Up 2.5 Degrees

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.0619	.0315	.0739	-.0132	.0121	-.0024	.0025	-.0052
RADIUS = .556 AMPLITUDE =	-.0717	.0008	.0406	-.0034	.0189	-.0116	.0102	-.0053
RADIUS = .775 AMPLITUDE =	-.1117	-.0127	-.0007	-.0007	.0057	-.0096	.0078	-.0100
RADIUS = 1.017 AMPLITUDE =	-.1120	-.0227	-.0234	-.0180	-.0197	-.0115	-.0051	-.0037
RADIUS = 1.178 AMPLITUDE =	-.1200	-.0320	-.0239	-.0256	-.0384	-.0260	-.0129	.0004

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.2371	.0692	.0981	-.0262	-.0061	.0125	-.0105	-.0081
RADIUS = .300 AMPLITUDE =	.1199	.0442	.0832	-.0175	.0067	.0023	-.0016	-.0060
RADIUS = .400 AMPLITUDE =	.0265	.0237	.0673	-.0106	.0150	-.0052	.0049	-.0049
RADIUS = .500 AMPLITUDE =	-.0431	.0078	.0505	-.0055	.0187	-.0100	.0089	-.0049
RADIUS = .600 AMPLITUDE =	-.0827	-.0023	.0307	-.0015	.0169	-.0109	.0104	-.0070
RADIUS = .700 AMPLITUDE =	-.1023	-.0086	.0112	.0004	.0112	-.0098	.0096	-.0095
RADIUS = .800 AMPLITUDE =	-.1111	-.0135	-.0043	-.0028	.0032	-.0087	.0064	-.0093
RADIUS = .900 AMPLITUDE =	-.1101	-.0172	-.0157	-.0105	-.0070	-.0076	.0010	-.0067

Table E4 - Input Data for Wake Survey Analysis for Experiment 5 with Fin Configuration 3 Leading Edge Up 2.5 Degrees

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
.6	.482	.019	.220
2.4	.453	.020	.220
4.2	.446	.031	.220
5.9	.440	.043	.220
9.5	.409	.061	.220
13.0	.381	.079	.209
16.6	.370	.096	.193
32.4	.386	.127	.084
48.6	.365	.109	.036
64.8	.405	.042	.013
81.0	.428	.016	.029
97.2	.477	-.023	.062
113.4	.635	-.005	.112
129.8	.700	.042	.124
145.9	.702	.069	.091
162.1	.619	.096	.027
165.9	.597	.104	.009
169.4	.585	.082	.001
173.0	.535	.082	-.020
176.6	.533	.061	-.027
178.4	.507	.050	-.030
180.3	.483	.032	-.039
182.2	.483	.023	-.041
183.9	.486	.018	-.043
185.8	.478	-.033	-.035
189.4	.477	-.054	-.021
193.0	.496	-.074	-.010
196.6	.512	-.084	.008
212.7	.606	-.088	.075
228.9	.637	-.050	.106
244.8	.620	.012	.097
260.9	.558	.012	.057
278.8	.402	-.036	.011
295.4	.372	-.081	.019
311.8	.361	-.127	.048
327.9	.393	-.126	.095
344.2	.400	-.062	.205
347.9	.397	-.062	.220
351.5	.395	-.047	.238
357.0	.357	-.011	.250
358.8	.444	.001	.250

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
.1	.194	-.019	-.009
1.9	.182	-.021	.042
3.6	.196	-.011	.096
7.3	.393	-.007	.238
9.1	.403	-.004	.232
12.7	.414	.008	.182
16.3	.424	.005	.171
19.8	.422	.008	.130
23.4	.428	.010	.107
27.0	.446	-.002	.089
30.6	.463	-.010	.072
46.8	.583	-.042	.019
63.0	.685	-.092	.002
79.3	.819	-.115	.002
95.5	.917	-.105	.005
111.7	.948	-.084	.018
127.9	.940	-.064	.046
144.0	.911	-.033	.081
147.6	.896	-.016	.093
151.2	.880	-.003	.102
153.0	.846	.003	.099
154.8	.815	.013	.101
156.7	.785	.028	.065
158.5	.754	.036	.081
160.4	.710	.042	.081
160.4	.727	.044	.070
163.9	.668	.053	.053
167.6	.604	.059	.012
171.2	.518	.050	-.038
174.8	.463	.041	-.064
176.5	.468	.038	-.089
178.4	.435	.020	-.104
178.5	.423	.024	-.105
180.3	.428	.005	-.117
182.1	.436	-.001	-.110
183.8	.426	-.002	-.099
185.6	.467	-.035	-.093
187.5	.430	-.038	-.080
189.3	.478	-.053	-.066
192.8	.526	-.061	-.036
192.9	.554	-.065	-.027
196.5	.628	-.067	.007
200.1	.670	-.056	.045
203.6	.743	-.044	.068
207.3	.790	-.022	.069
209.1	.780	-.010	.066
210.9	.797	-.003	.086
227.0	.846	.049	.068
243.2	.852	.070	.039
259.4	.843	.086	.020
275.6	.780	.089	.018
291.7	.658	.073	.005
307.9	.528	.037	.021
324.0	.467	-.006	.067
340.2	.423	-.041	.166
343.8	.420	-.037	.191
347.4	.408	-.032	.226
351.0	.399	-.021	.249
354.6	.204	-.028	.140
358.3	.190	-.019	-.006

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
.6	.417	.004	.263
2.4	.407	-.008	.260
4.2	.407	-.012	.254
6.0	.425	-.027	.236
9.7	.437	-.034	.201
13.3	.461	-.031	.174
16.9	.465	-.040	.141
16.9	.468	-.042	.136
33.1	.537	-.069	.060
49.3	.704	-.100	.011
65.6	.841	-.121	-.028
81.8	.902	-.114	-.022

Table E4 - Continued

97.9	.924	-.106	.014
114.1	.923	-.094	.041
130.3	.929	-.080	.062
146.0	.919	-.068	.083
162.4	.910	-.040	.108
166.3	.893	-.006	.115
169.7	.824	.042	.111
173.3	.697	.083	.072
176.8	.598	.078	008
178.6	.525	.067	-.023
180.5	.458	.055	-.053
182.3	.442	.013	-.061
184.2	.455	-.021	-.054
185.9	.489	-.054	-.033
189.6	.579	-.069	.036
193.0	.776	-.049	.087
196.7	.834	-.009	.113
212.7	.901	.060	.086
228.8	.924	.070	.069
244.8	.923	.084	.046
260.9	.938	.098	.020
277.0	.931	.112	-.010
293.3	.875	.114	-.020
309.6	.766	.094	.017
325.7	.599	.072	.074
341.8	.521	.043	.148
345.5	.493	.029	.176
349.0	.467	.023	.208
352.6	.450	.015	.246
356.1	.427	.008	.260
358.0	.431	.011	.263
358.8	.407	.004	.253
359.8	.402	-.007	.264

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
.7	.455	-.061	.173
2.5	.474	-.079	.161
4.3	.479	-.077	.155
6.2	.479	-.093	.147
9.7	.507	-.105	.119
13.3	.527	-.114	.104
17.0	.544	-.123	.097
33.0	.616	-.125	.055
49.1	.768	-.089	-.022
65.1	.893	-.096	-.062
65.5	.898	-.097	-.059
81.1	.925	-.104	-.031
97.1	.930	-.101	.002
113.3	.934	-.087	.023
129.6	.929	-.070	.041
145.8	.932	-.059	.048
161.8	.932	-.046	.050
165.5	.932	-.047	.050
169.1	.933	-.037	.054
172.7	.930	.012	.072
176.3	.802	.070	.026
178.2	.617	.035	-.013
180.3	.619	-.054	-.007
182.2	.697	-.086	.020
184.0	.815	-.079	.048
185.8	.899	-.038	.069
189.5	.908	.029	.057
193.1	.928	.040	.052
196.7	.926	.042	.050
212.6	.931	.053	.051
213.0	.926	.054	.051
229.0	.919	.070	.044
245.5	.931	.082	.026
261.5	.927	.098	.004
277.9	.932	.105	-.026
294.2	.904	.099	-.055
310.4	.823	.077	-.011
326.4	.671	.106	.074
342.5	.541	.101	.124
346.2	.510	.083	.138
349.7	.487	.074	.156
353.4	.481	.056	.167
357.1	.471	.028	.177
358.9	.453	-.017	.186
360.7	.455	-.061	.173

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
.6	.455	-.024	.041
2.4	.453	-.081	.062
4.2	.441	-.109	.089
5.9	.440	-.133	.113
9.5	.492	-.138	.126
13.0	.485	-.166	.143
16.6	.493	-.162	.149
32.4	.575	-.178	.164
48.6	.725	-.082	.026
64.8	.835	-.126	-.081
81.0	.886	-.135	-.010
97.2	.900	-.108	.031
113.4	.904	-.088	.058
129.8	.904	-.072	.074
145.9	.912	-.052	.080
162.1	.914	-.039	.079
165.9	.912	-.037	.079
169.4	.910	-.034	.075
173.0	.918	-.030	.071
176.6	.922	-.020	.066
178.4	.928	-.012	.064
180.3	.699	-.002	.076
182.2	.895	.006	.061
183.9	.940	.014	.063
185.8	.938	.020	.064
189.4	.935	.023	.068
193.0	.936	.026	.071
196.6	.938	.030	.072
212.7	.933	.045	.074
228.9	.939	.059	.068
244.9	.939	.078	.049
260.9	.950	.092	.029
278.8	.940	.144	-.015
295.4	.907	.083	-.043
311.8	.881	.037	.021
327.9	.789	.112	.102
344.2	.613	.146	.120
347.9	.566	.151	.118
351.5	.532	.131	.105
355.3	.492	.111	.086
357.0	.496	.081	.065
358.9	.485	.016	.043

APPENDIX F

EXPERIMENT 6

FIN CONFIGURATION 2 (NAVY)

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

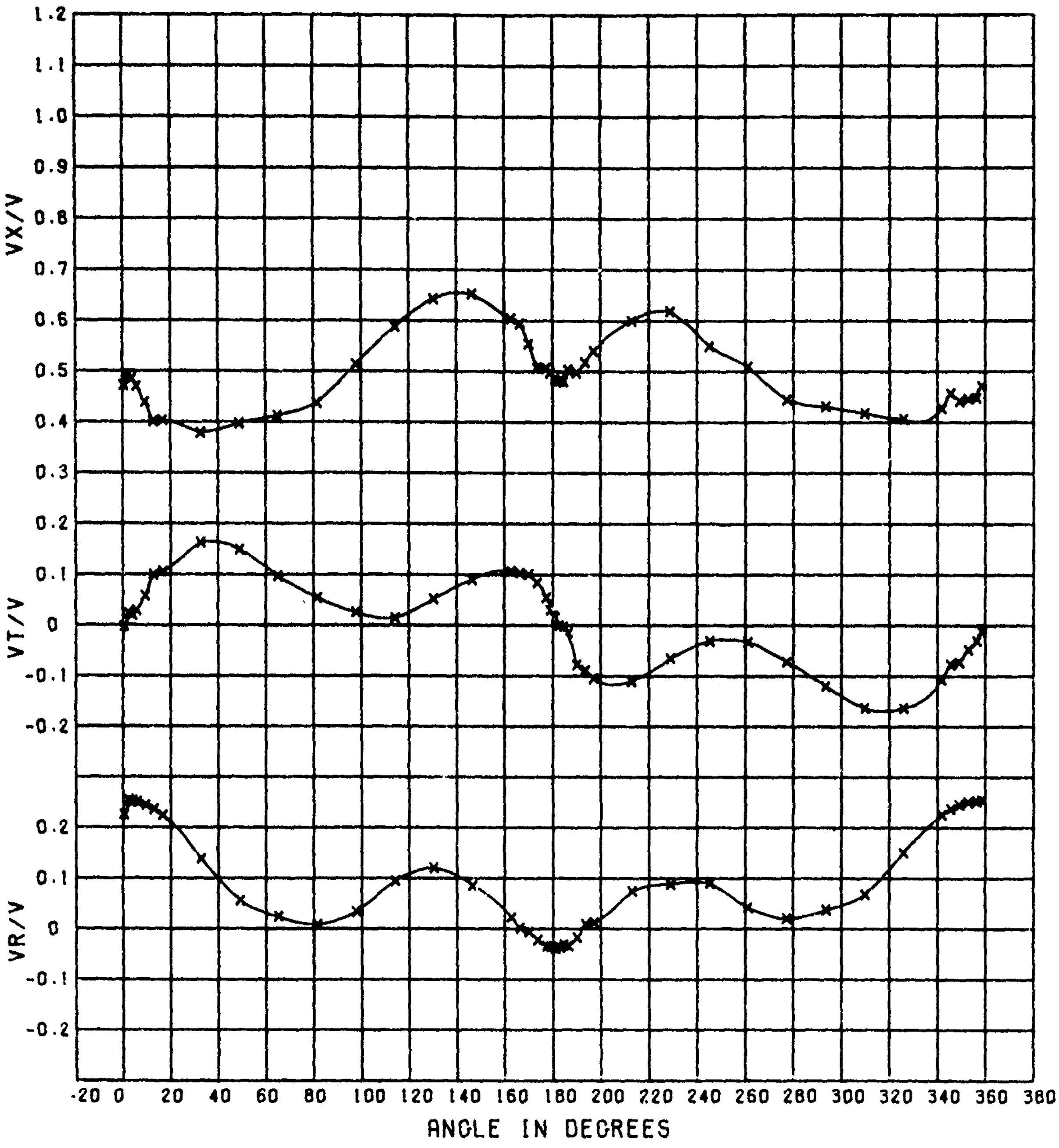


Figure F1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 6
Radius Ratio = 0.359

Fin Configuration 2 (Navy)
Displacement 26,390 tons (26 810 metric tons)

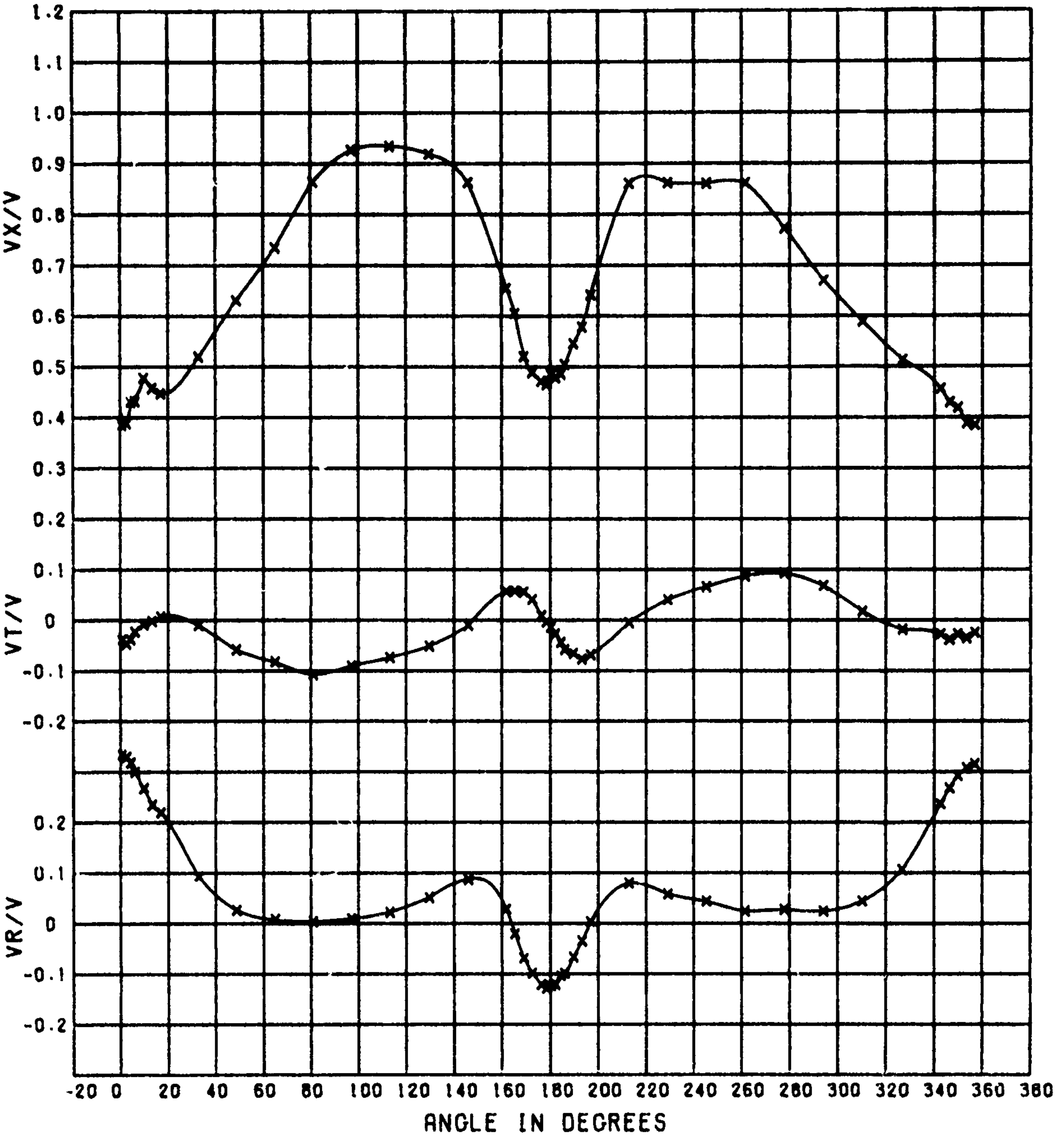


Figure F2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 6
Radius Ratio = 0.556

Fin Configuration 2 (Navy)
Displacement 26,390 tons (26 810 metric tons)

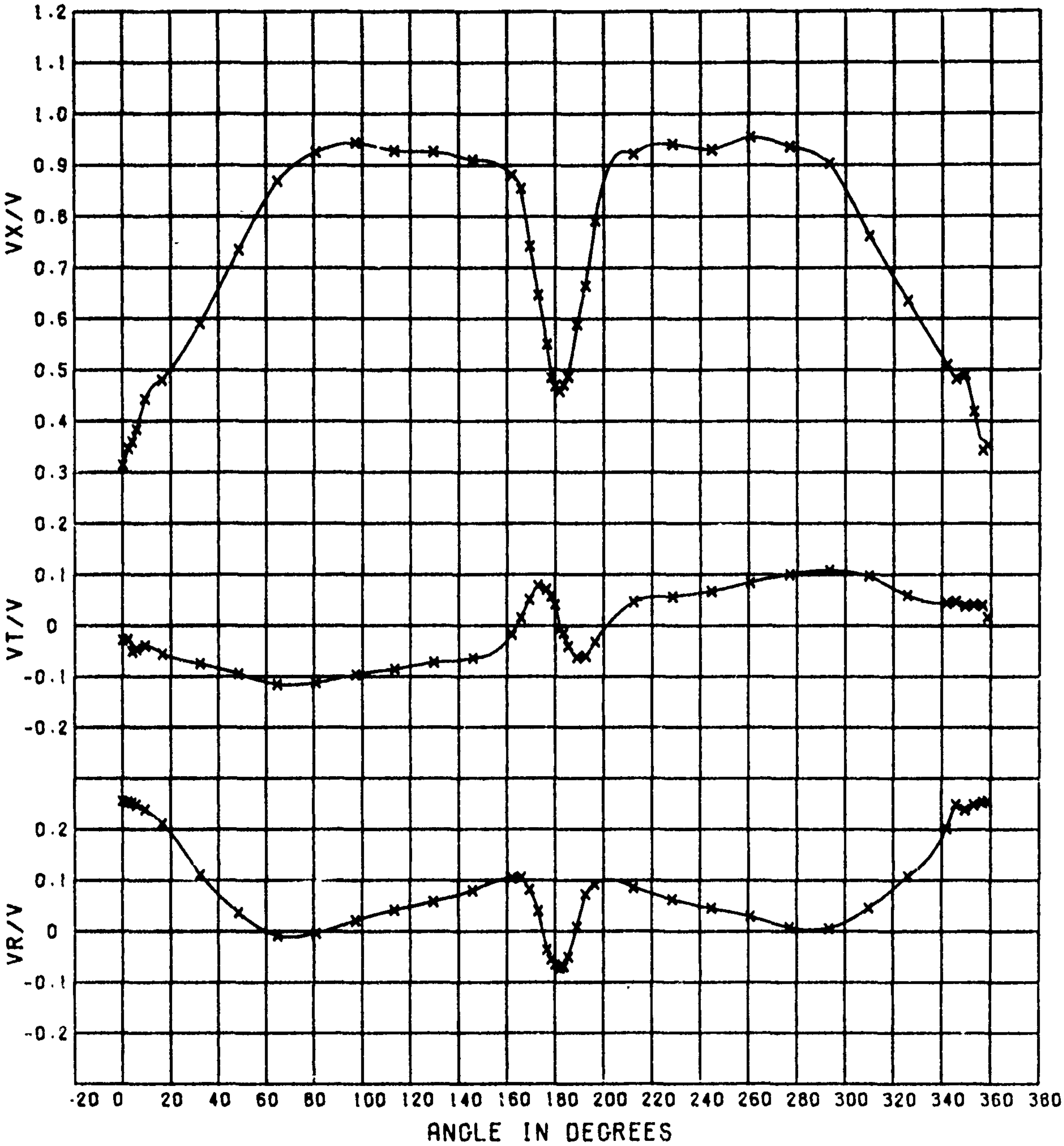


Figure F3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 6
Radius Ratio = 0.775

Fin Configuration 2 (Navy)
Displacement 26,390 tons (26 810 metric tons)

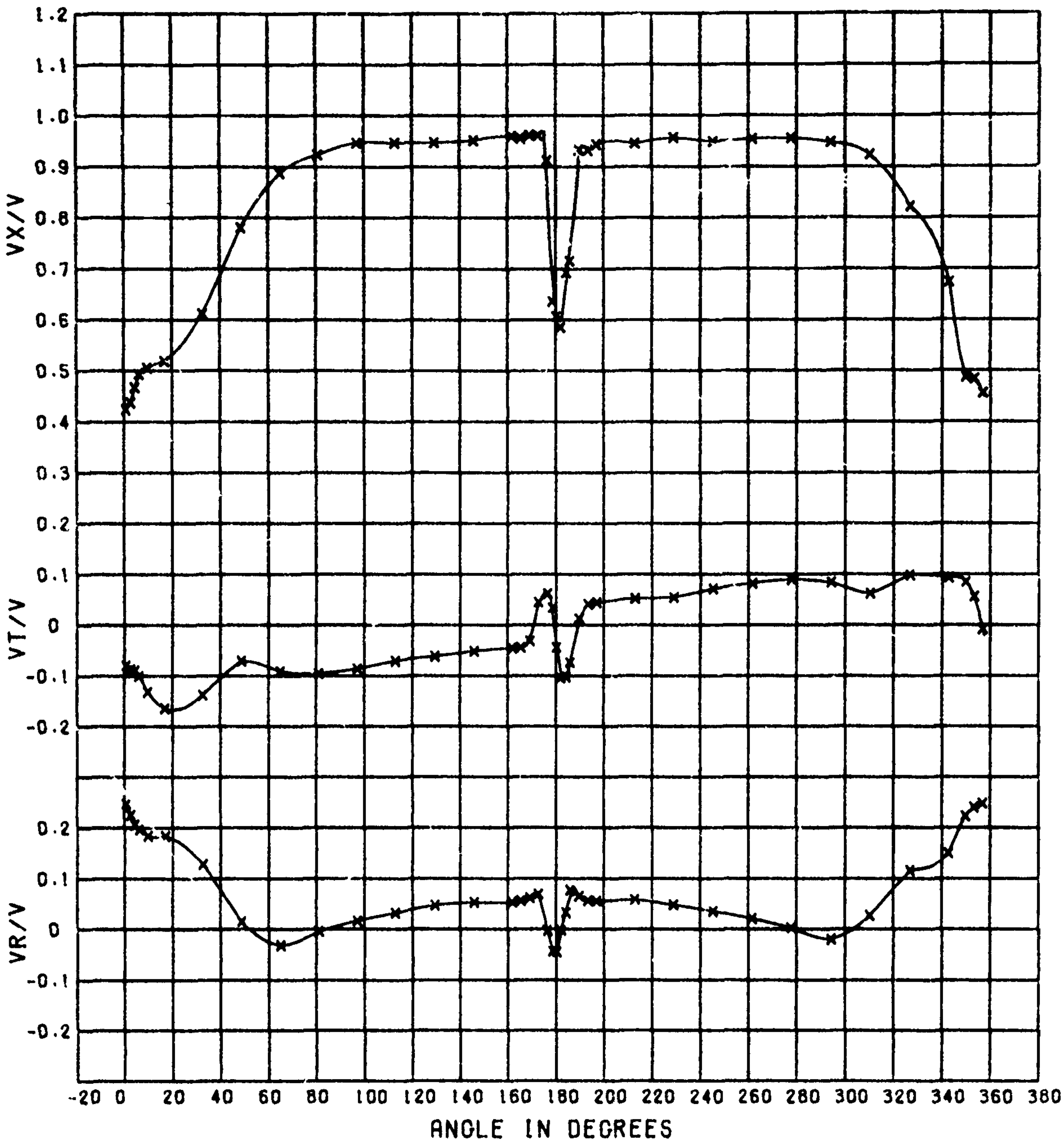


Figure F4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 6
Radius Ratio = 1.107

Fin Configuration 2 (Navy)
Displacement 26,390 tons (26 810 metric tons)

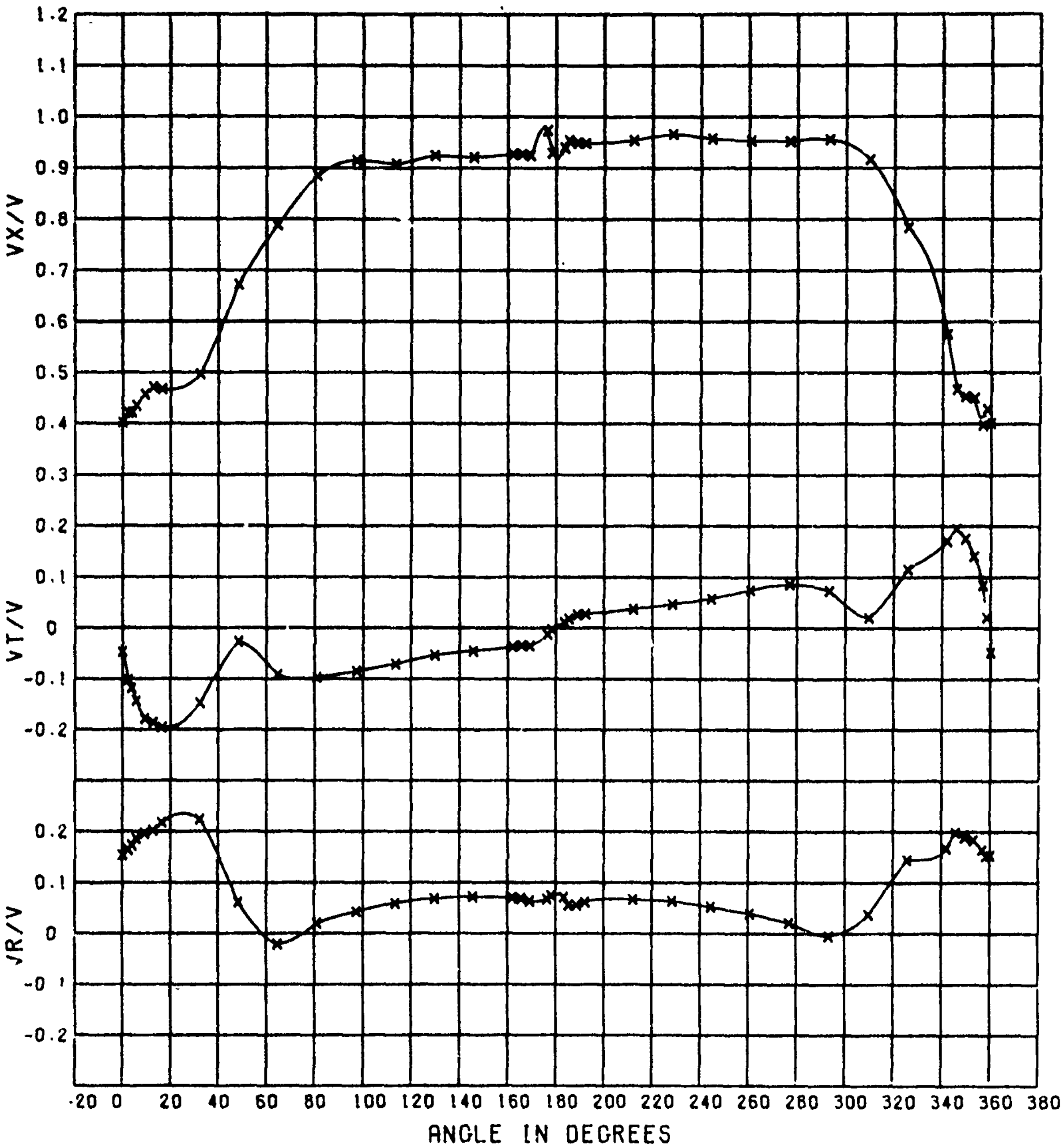


Figure F5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 6
Radius Ratio = 1.178

Fin Configuration 2 (Navy)
Displacement 26,390 tons (26 810 metric tons)

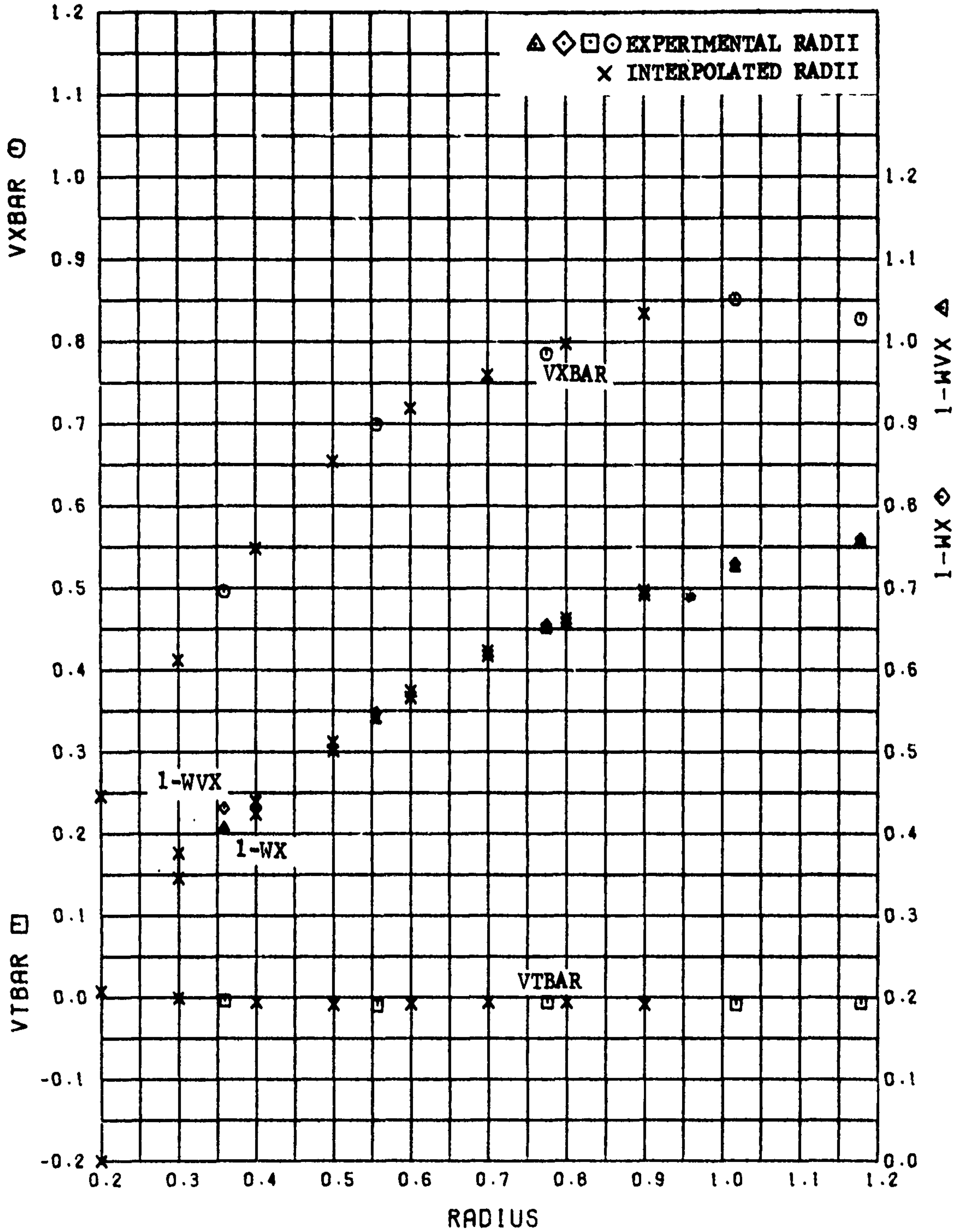


Figure F6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 6

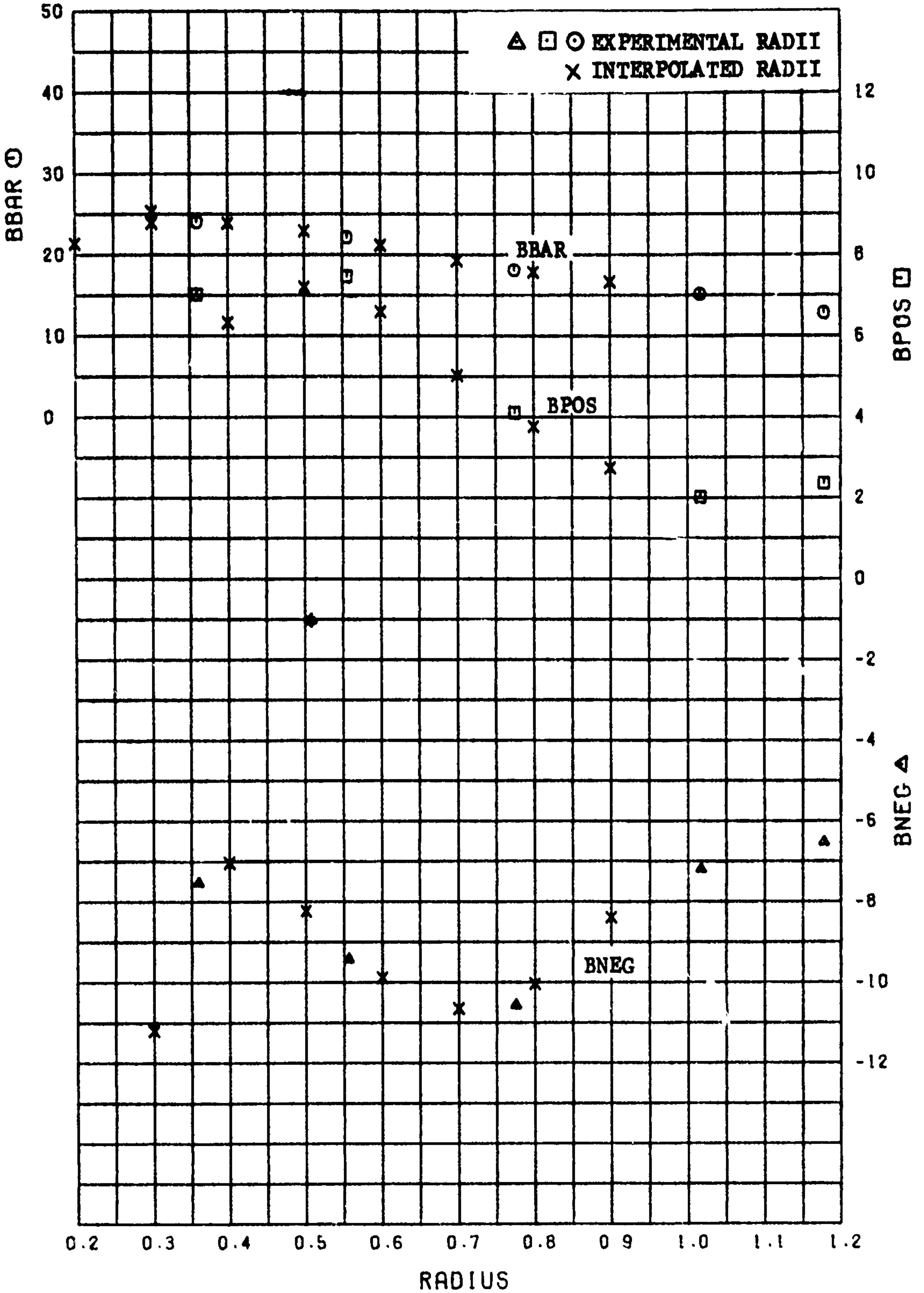


Figure F7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 6

Table F1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 6 with Fin Configuration 2

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.496	.699	.785	.851	.827	.246	.412	.548	.654	.719	.759	.758	.834
VTBAR =	-.004	-.010	-.006	-.009	-.007	.007	-.001	-.006	-.009	-.008	-.006	-.006	-.009
VRBAR =	.083	.063	.070	.057	.077	.118	.094	.077	.066	.066	.070	.067	.057
1-WVX =	.407	.539	.649	.724	.755	0.000	.346	.424	.501	.566	.617	.657	.692
1-WX =	.431	.548	.655	.729	.759	0.000	.376	.439	.512	.574	.623	.663	.697
BBAR =	24.04	22.13	18.08	15.09	12.75	21.34	23.86	23.88	22.91	21.14	19.26	17.81	16.64
BPOS =	7.02	7.47	4.10	2.01	2.35	27.61	9.06	6.32	7.20	6.58	5.02	3.76	2.73
THETA =	220.00	105.00	95.00	157.50	175.00	315.00	202.50	217.50	112.50	102.50	97.50	95.00	97.50
BNEG =	-7.53	-9.43	-10.58	-7.20	-6.54	-32.05	-11.21	-7.04	-8.24	-9.89	-10.66	-10.05	-8.40
THETA =	32.50	337.50	0.00	0.00	355.00	85.00	80.00	30.00	355.00	357.50	0.00	0.00	0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLFS (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table F2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 6 with Fin Configuration 2

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1029	.0035	.0518	-.0205	.0206	.0007	.0116	.0009
RADIUS = .556 AMPLITUDE =	-.1380	-.1812	.0645	-.0433	.0313	-.0315	.0144	-.0047
RADIUS = .775 AMPLITUDE =	-.1428	-.1935	-.0042	-.0580	.0398	-.0423	.0222	-.0326
RADIUS = 1.017 AMPLITUDE =	-.1432	-.1294	-.0458	-.0473	.0029	-.0247	.0100	-.0217
RADIUS = 1.178 AMPLITUDE =	-.1925	-.1196	-.0582	-.0214	-.0074	-.0027	-.0043	-.0001

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.0533	.2726	-.0100	.0045	.0099	.0422	.0122	-.0079
RADIUS = .300 AMPLITUDE =	-.0867	.0909	.0342	-.0119	.0168	.0145	.0115	-.0010
RADIUS = .400 AMPLITUDE =	-.1126	-.0485	.0603	-.0260	.0230	-.0078	.0118	.0013
RADIUS = .500 AMPLITUDE =	-.1310	-.1454	.0681	-.0377	.0285	-.0245	.0132	-.0013
RADIUS = .600 AMPLITUDE =	-.1393	-.1890	.0484	-.0481	.0362	-.0357	.0174	-.0132
RADIUS = .700 AMPLITUDE =	-.1417	-.1900	.0100	-.0556	.0414	-.0415	.0215	-.0271
RADIUS = .800 AMPLITUDE =	-.1388	-.1841	-.0098	-.0585	.0348	-.0413	.0214	-.0327
RADIUS = .900 AMPLITUDE =	-.1320	-.1530	-.0291	-.0567	.0176	-.0355	.0173	-.0302

Table F3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 6 with Fin Configuration 2

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.1049	.0406	.0746	-.0166	.0146	-.0069	.0022	-.0033
RADIUS = .556 AMPLITUDE =	-.0643	-.0048	.0428	-.0062	.0170	-.0123	.0091	-.0051
RADIUS = .775 AMPLITUDE =	-.1023	-.0201	.0003	-.0044	.0063	-.0148	.0064	-.0138
RADIUS = 1.017 AMPLITUDE =	-.1000	-.0254	-.0277	-.0216	-.0246	-.0170	-.0063	-.0062
RADIUS = 1.178 AMPLITUDE =	-.0940	-.0293	-.0343	-.0359	-.0460	-.0306	-.0203	-.0055

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.3349	.0990	.0958	-.0311	.0045	-.0003	-.0097	-.0059
RADIUS = .300 AMPLITUDE =	.1805	.0600	.0829	-.0214	.0117	-.0047	-.0015	-.0038
RADIUS = .400 AMPLITUDE =	.0592	.0286	.0685	-.0138	.0160	-.0083	.0043	-.0032
RADIUS = .500 AMPLITUDE =	-.0292	.0050	.0524	-.0083	.0175	-.0111	.0080	-.0040
RADIUS = .600 AMPLITUDE =	-.0750	-.0087	.0329	-.0045	.0162	-.0129	.0092	-.0080
RADIUS = .700 AMPLITUDE =	-.0936	-.0160	.0130	-.0032	.0118	-.0140	.0083	-.0125
RADIUS = .800 AMPLITUDE =	-.1024	-.0206	-.0036	-.0060	.0032	-.0140	.0056	-.0126
RADIUS = .900 AMPLITUDE =	-.1021	-.0228	-.0169	-.0127	-.0095	-.0132	.0011	-.0089

Table F4 - Input Data for Wake Survey Analysis for Experiment 6 with Fin Configuration 2

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
.4	.472	-.003	.225
2.3	.493	.024	.254
4.0	.485	.020	.252
5.8	.470	.029	.250
9.5	.438	.058	.244
13.0	.401	.100	.236
16.7	.403	.106	.224
32.7	.379	.162	.138
49.0	.397	.149	.055
65.2	.413	.097	.023
81.5	.438	.054	.008
97.8	.514	.025	.034
114.2	.588	.014	.094
130.4	.643	.052	.120
146.6	.652	.090	.085
162.8	.603	.107	.022
166.3	.595	.103	.001
170.0	.554	.100	-.007
173.6	.507	.084	-.023
177.3	.506	.055	-.035
179.0	.497	.031	-.035
180.9	.484	.031	-.039
182.7	.481	-.001	-.037
184.5	.479	-.002	-.032
186.3	.503	-.015	-.035
190.0	.497	-.078	-.018
193.5	.517	-.089	.008
197.2	.540	-.105	.012
212.9	.600	-.111	.074
228.9	.619	-.066	.087
245.1	.550	-.031	.090
261.0	.509	-.033	.041
277.3	.444	-.072	.020
293.6	.431	-.120	.037
309.8	.418	-.164	.068
325.8	.407	-.164	.150
341.9	.427	-.108	.225
345.6	.456	-.077	.237
349.1	.441	-.074	.245
352.8	.446	-.047	.250
356.3	.447	-.031	.253
358.2	.473	-.006	.254
358.6	.469	-.018	.254
359.9	.466	.001	.255

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
.6	.385	-.039	.333
2.6	.388	-.047	.329
4.3	.431	-.039	.318
5.1	.431	-.023	.299
9.7	.477	-.008	.267
13.2	.457	-.002	.234
16.9	.447	.007	.219
32.7	.519	-.011	.092
48.7	.631	-.059	.026
64.9	.734	-.083	.008
80.9	.864	-.108	.003
97.1	.926	-.091	.009
113.2	.934	-.074	.022
129.5	.919	-.052	.051
145.9	.863	-.010	.086
161.8	.654	.057	.028
165.4	.605	.058	-.021
169.1	.520	.056	-.069
172.6	.488	.041	-.099
176.3	.471	.009	-.121
178.1	.467	-.003	-.129
178.8	.463	-.005	-.129
179.8	.484	-.007	-.121
180.6	.486	-.021	-.126
181.7	.487	-.023	-.125
182.4	.470	-.032	-.118
184.3	.486	-.044	-.104
186.0	.504	-.059	-.100
189.7	.545	-.067	-.067
193.3	.578	-.078	-.035
196.9	.641	-.069	.003
212.9	.861	-.005	.079
229.1	.861	.040	.057
245.3	.860	.066	.043
261.6	.861	.087	.023
277.8	.772	.093	.027
294.2	.670	.068	.024
310.4	.589	.017	.044
326.7	.513	-.019	.106
342.6	.456	-.028	.236
346.3	.429	-.039	.267
349.8	.418	-.028	.292
353.4	.388	-.036	.307
356.9	.384	-.025	.315
358.9	.380	-.039	.333

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
0.0	.314	-.029	.255
2.3	.346	-.027	.254
4.0	.359	-.052	.252
5.8	.384	-.047	.248
9.4	.443	-.040	.236
16.5	.479	-.057	.211
32.3	.589	-.075	.111
48.4	.734	-.095	.036
64.6	.868	-.116	-.009
80.9	.924	-.113	-.004
97.1	.943	-.097	.021
113.4	.927	-.086	.041
129.7	.926	-.073	.058
145.8	.910	-.064	.079
161.9	.880	-.018	.105
165.7	.854	.015	.106
169.3	.743	.051	.082
172.9	.646	.078	.040
176.5	.550	.071	-.037
178.3	.485	.057	-.057
180.0	.468	.042	-.066
181.9	.458	-.007	-.072
183.6	.471	-.014	-.070
185.4	.487	-.041	-.051

Table F4 - Continued

189.0	.588	-.063	.008
192.5	.664	-.061	.072
196.3	.791	-.032	.092
212.2	.921	.046	.085
228.5	.940	.056	.062
244.6	.929	.067	.045
260.7	.955	.084	.029
276.9	.936	.100	.007
293.3	.903	.108	.005
309.8	.761	.097	.045
325.8	.635	.059	.108
342.0	.509	.044	.201
345.8	.483	.047	.248
349.4	.490	.039	.238
353.0	.418	.041	.248
356.6	.343	.040	.253
358.4	.358	.022	.254
358.8	.346	.009	.254

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
.6	.424	-.080	.247
2.6	.437	-.088	.225
4.3	.408	-.090	.200
6.1	.492	-.101	.196
9.7	.505	-.133	.184
16.9	.518	-.165	.183
32.7	.612	-.138	.128
48.7	.780	-.071	.015
64.9	.887	-.092	-.033
80.9	.923	-.096	-.005
97.1	.947	-.087	.016
113.2	.947	-.071	.032
129.5	.947	-.062	.046
145.9	.951	-.052	.052
161.8	.959	-.046	.053
165.4	.956	-.044	.056
169.1	.961	-.032	.061
172.6	.960	.044	.068
176.3	.911	.062	-.004
178.1	.726	.028	-.036
178.8	.548	.038	-.052
179.8	.617	-.040	-.041
180.6	.596	-.049	-.051
181.7	.597	-.099	-.008
182.4	.573	-.109	.003
184.3	.693	-.103	.032
186.0	.715	-.074	.076
189.7	.932	.012	.064
193.3	.932	.040	.056
196.9	.943	.044	.055
212.9	.945	.051	.058
229.1	.956	.055	.048
245.3	.948	.071	.035
261.6	.954	.082	.020
277.8	.955	.089	.002
294.2	.947	.083	-.020
310.4	.923	.062	.026
326.7	.821	.098	.115
342.6	.673	.092	.150
349.8	.486	.085	.222
353.4	.483	.056	.240
356.9	.455	-.008	.247
358.9	.431	-.048	.249

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
0.0	.402	-.048	.153
2.3	.421	-.103	.164
4.0	.421	-.119	.173
5.8	.435	-.145	.186
9.4	.457	-.179	.195
12.9	.471	-.186	.202
16.5	.467	-.196	.217
32.3	.496	-.148	.223
48.4	.672	-.028	.061
64.6	.788	-.093	-.022
80.9	.885	-.098	.020
97.1	.915	-.085	.042
113.4	.907	-.072	.059
129.7	.924	-.055	.068
145.8	.920	-.046	.072
161.9	.926	-.038	.070
165.7	.926	-.035	.068
169.3	.924	-.036	.064
176.5	.973	-.013	.067
178.3	.929	-.004	.074
183.6	.939	.011	.071
185.4	.954	.018	.055
189.0	.949	.026	.056
192.5	.948	.027	.061
212.2	.954	.037	.067
228.5	.966	.047	.063
244.6	.957	.057	.052
260.7	.953	.074	.038
276.9	.952	.086	.021
293.3	.955	.073	-.005
309.8	.916	.020	.037
325.8	.784	.115	.144
342.0	.576	.170	.167
345.8	.467	.194	.198
349.4	.453	.175	.188
353.0	.450	.140	.183
356.6	.397	.084	.164
358.4	.428	.020	.152
360.0	.402	-.048	.153

APPENDIX G

EXPERIMENT 7

FIN CONFIGURATION 4 (SSPA)

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

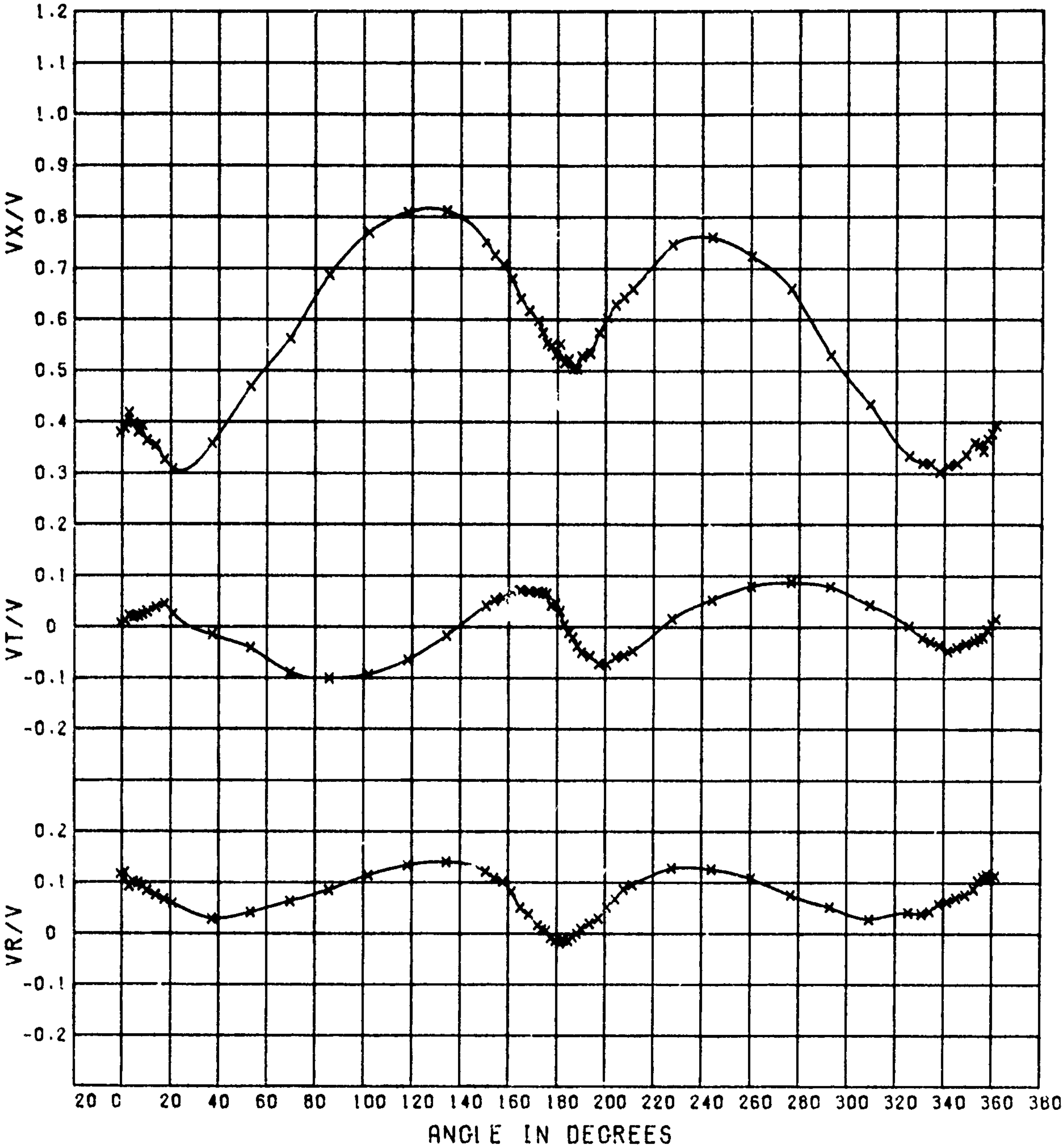


Figure G1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 7
Radius Ratio = 0.359

Fin Configuration 4 (SSPA)
Displacement 26,390 tons (26 810 metric tons)

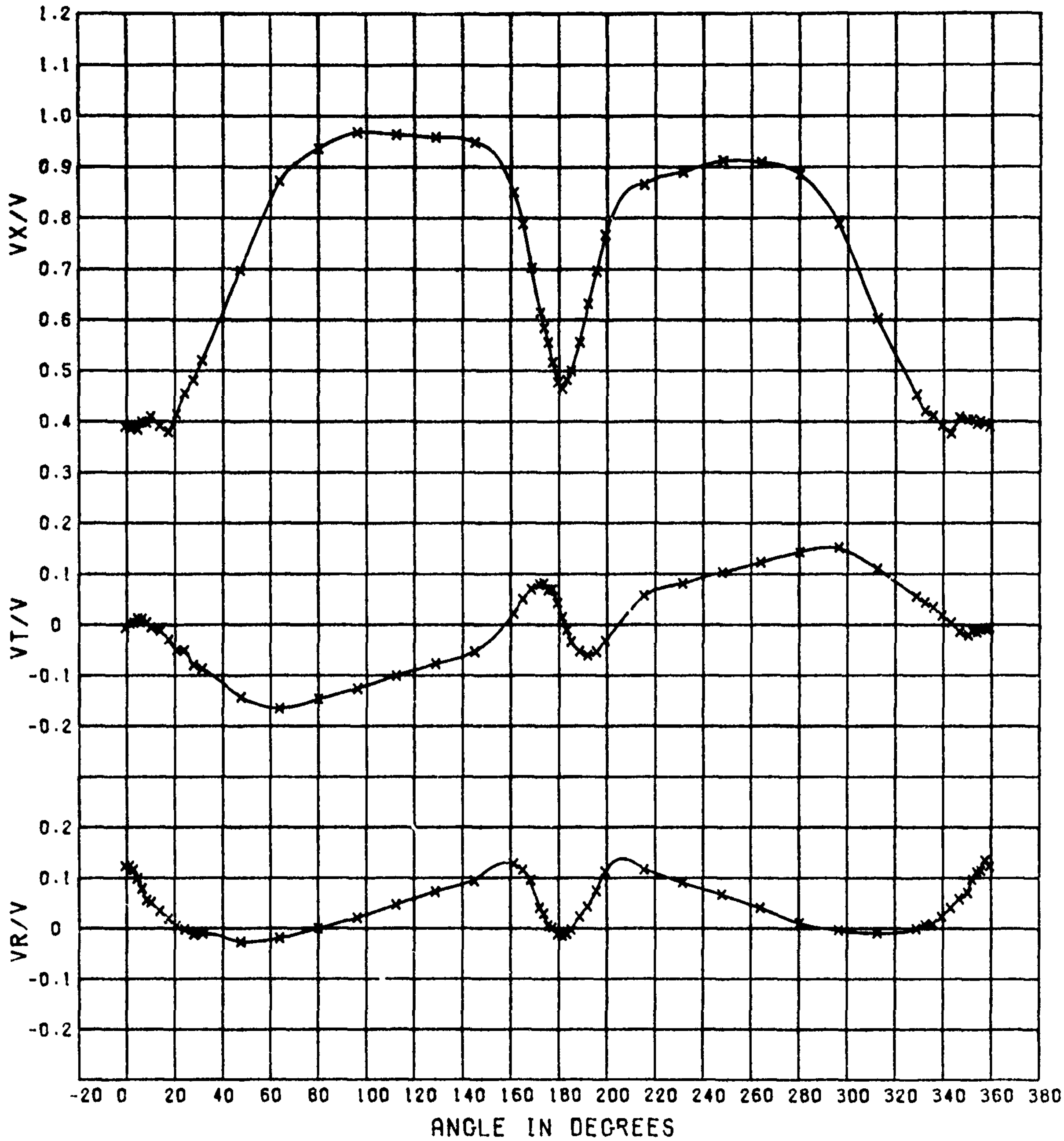


Figure G2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 7
Radius Ratio = 0.556

Fin Configuration 4 (SSPA)
Displacement 26,390 tons (26 810 metric tons)

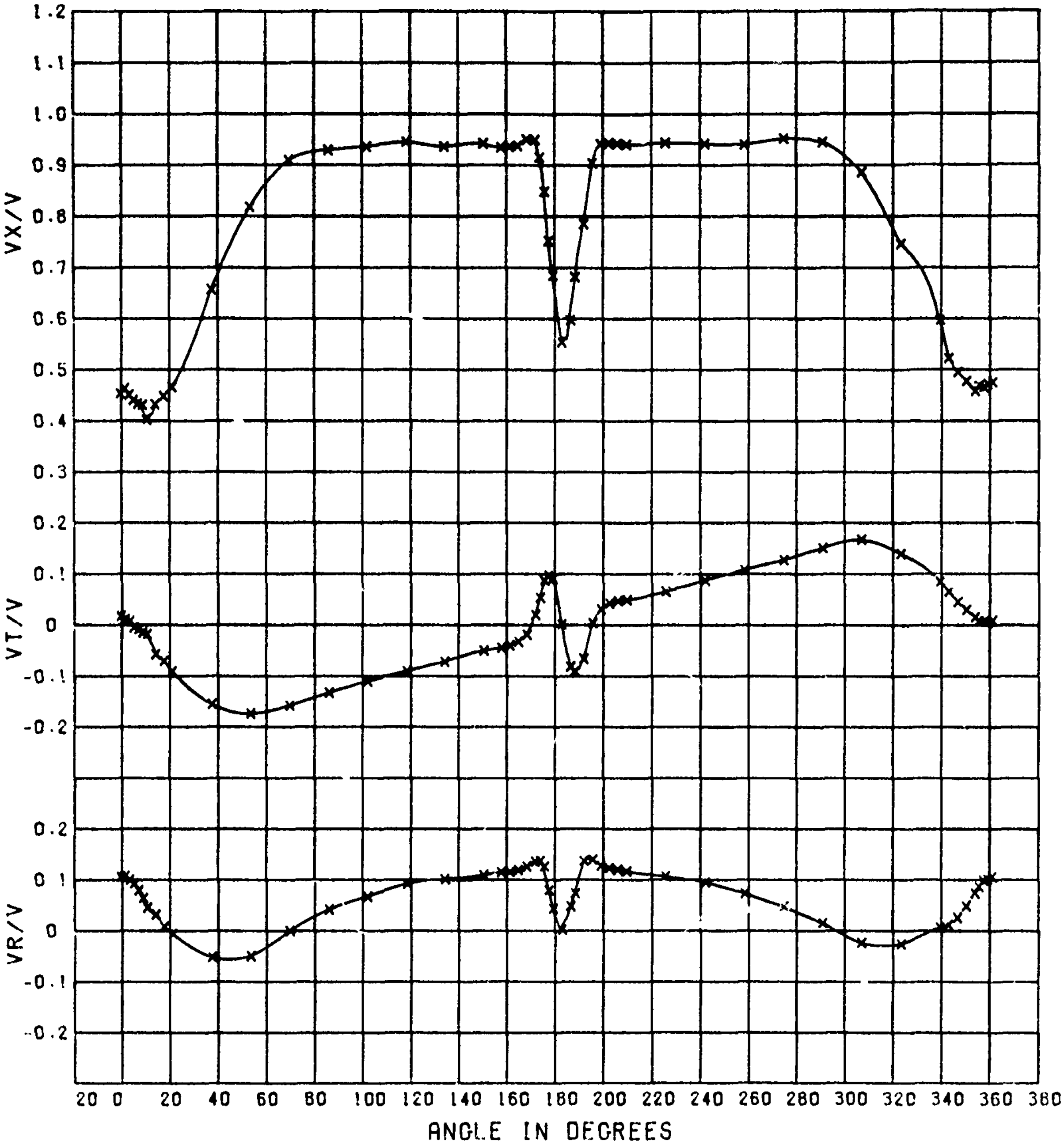


Figure G3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 7
Radius Ratio = 0.775

Fin Configuration 4 (SSPA)
Displacement 26,390 tons (26 810 metric tons)

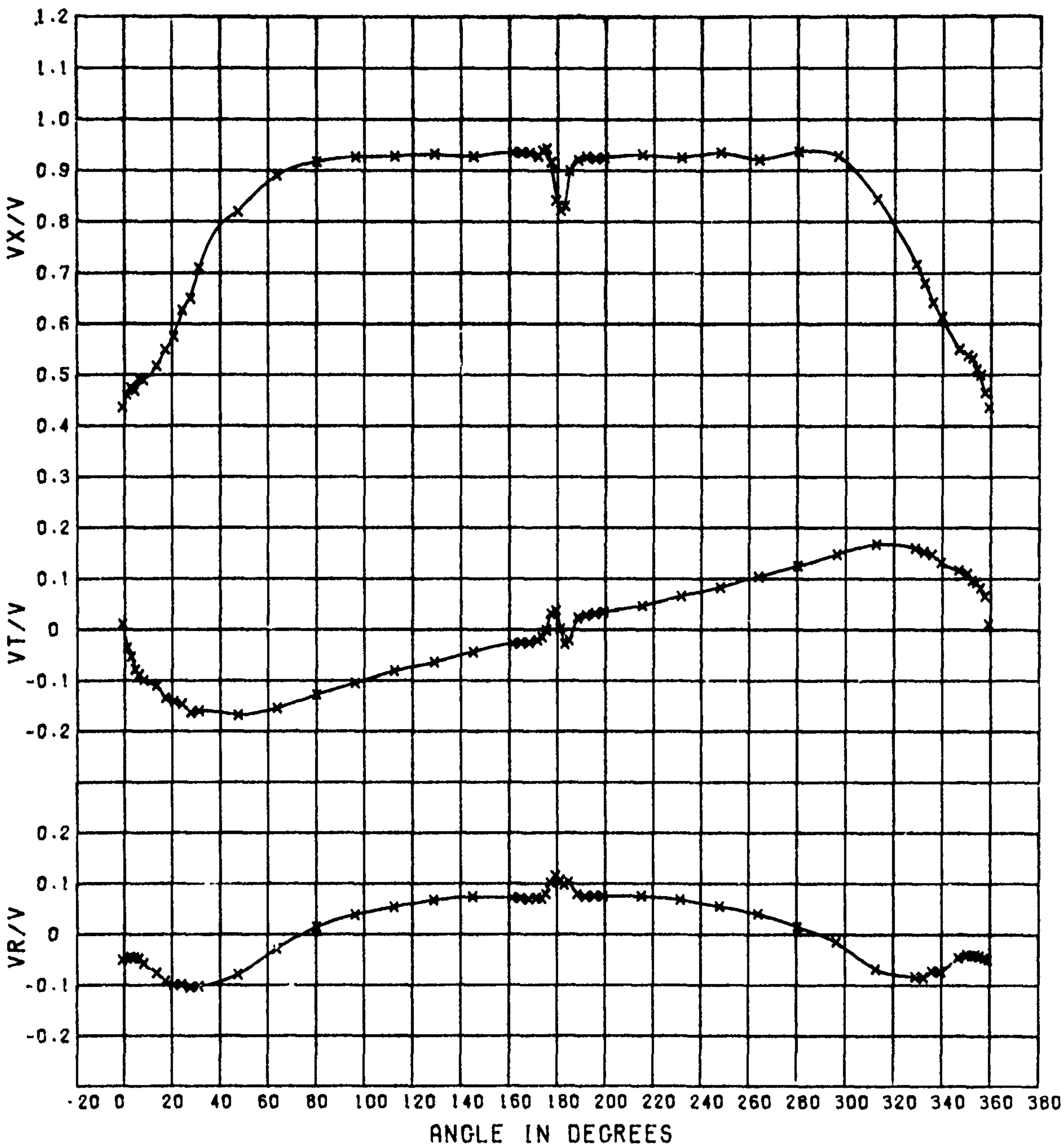


Figure G4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 7
Radius Ratio = 1.107

Fin Configuration 4 (SSPA)
Displacement 26,390 tons (26 810 metric tons)

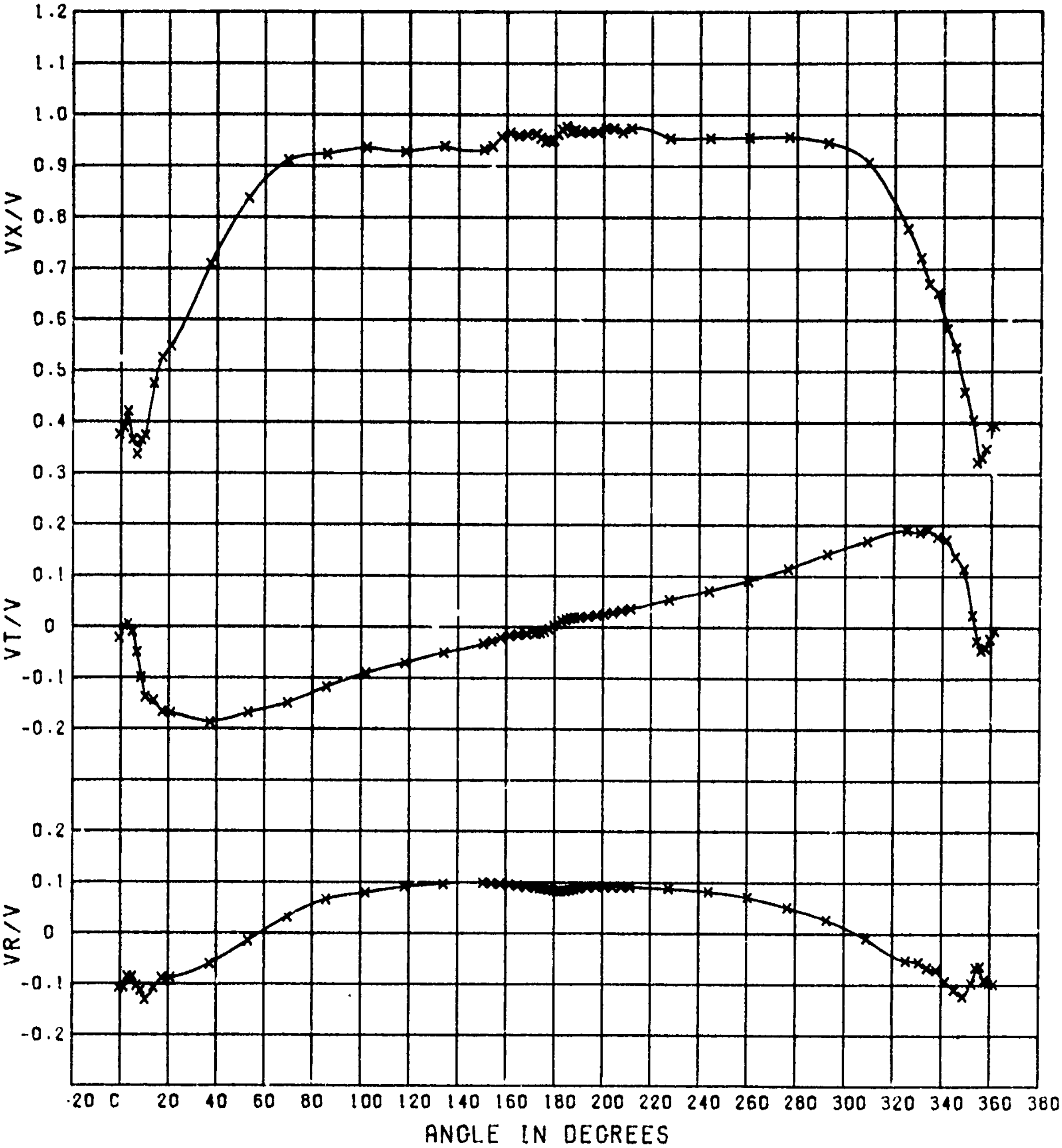


Figure G5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 7
Radius Ratio = 1.178

Fin Configuration 4 (SSPA)
Displacement 26,390 tons (26 810 metric tons)

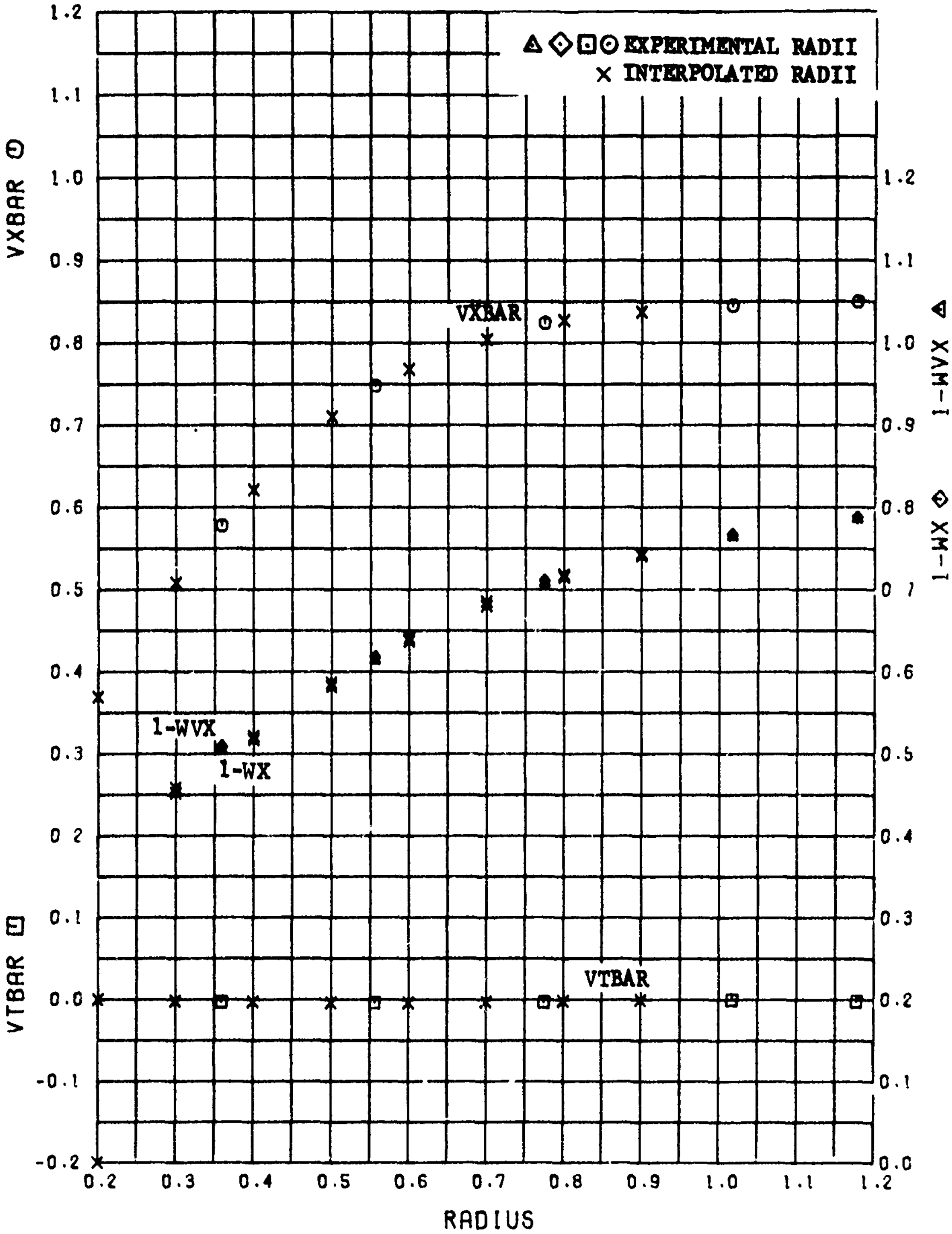


Figure G6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 7

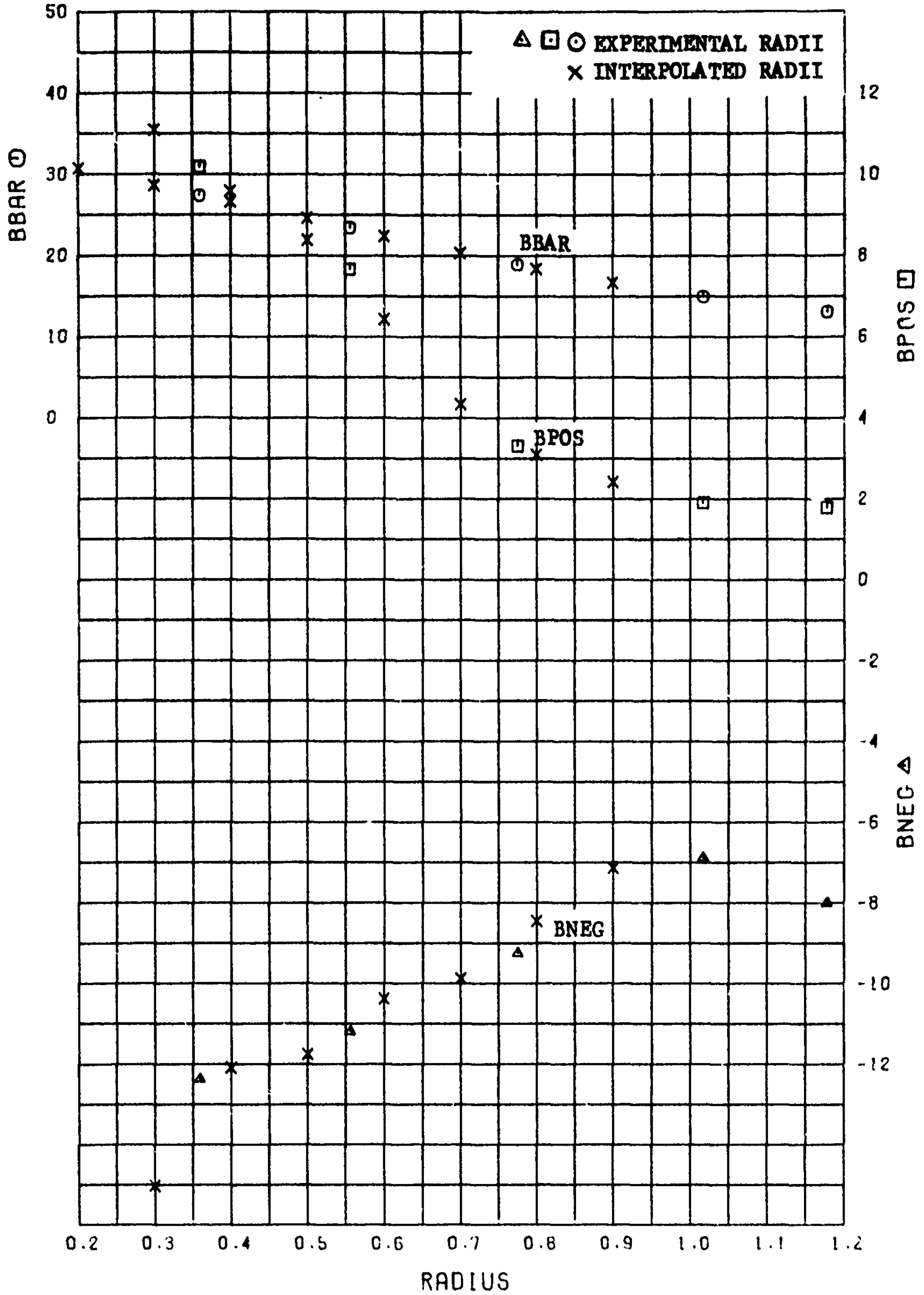


Figure G7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 7

Table G1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 7 with Fin Configuration 4

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.578	.748	.824	.845	.850	.369	.508	.621	.710	.768	.804	.827	.837
VTBAR =	-.003	-.004	-.003	-.000	-.002	-.000	-.002	-.003	-.004	-.004	-.003	-.002	-.001
VRBAR =	.077	.041	.050	.010	.030	.135	.095	.066	.047	.046	.051	.042	.019
1-WVX =	.503	.613	.707	.764	.786	0.000	.452	.517	.582	.637	.680	.715	.741
1-WX =	.509	.618	.711	.767	.788	0.000	.458	.521	.586	.641	.685	.718	.744
BBAR =	27.40	23.44	18.89	14.96	13.06	30.68	28.59	26.58	24.58	22.40	20.30	18.40	16.65
BPOS =	10.18	7.67	3.31	1.90	1.78	20.40	11.08	9.58	8.38	6.43	4.33	3.09	2.41
THETA =	115.00	95.00	80.00	90.00	185.00	172.50	117.50	112.50	100.00	95.00	92.50	82.50	87.50
BNEG =	-12.38	-11.20	-9.25	-6.89	-8.01	-28.80	-15.03	-12.09	-11.76	-10.39	-9.88	-8.46	-7.14
THETA =	22.50	342.50	10.00	0.00	355.00	62.50	27.50	337.50	342.50	5.00	10.00	10.00	0.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	1.0 ft by the bow (0.305 m)
Displacement	26,390 tons (26 810 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table G2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 7 with Fin Configuration 4

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1865	-.1242	.0668	-.0035	.0256	.0027	.0124	.0062
RADIUS = .556 AMPLITUDE =	-.1721	-.2135	.0159	-.0398	.0552	-.0227	.0299	-.0177
RADIUS = .775 AMPLITUDE =	-.1562	-.1555	-.0421	-.0488	.0207	-.0184	.0207	-.0167
RADIUS = 1.017 AMPLITUDE =	-.1454	-.1115	-.0611	-.0343	-.0084	-.0073	.0004	-.0053
RADIUS = 1.178 AMPLITUDE =	-.1828	-.1253	-.0842	-.0408	-.0218	-.0134	-.0085	-.0085

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.1980	.0457	.1072	.0452	-.0402	.0435	-.0171	.0424
RADIUS = .300 AMPLITUDE =	-.1907	-.0713	.0819	.0125	.0056	.0157	.0039	.0178
RADIUS = .400 AMPLITUDE =	-.1835	-.1538	.0563	-.0133	.0365	-.0049	.0187	-.0007
RADIUS = .500 AMPLITUDE =	-.1762	-.2017	.0305	-.0322	.0526	-.0183	.0276	-.0133
RADIUS = .600 AMPLITUDE =	-.1684	-.2005	.0011	-.0433	.0477	-.0223	.0287	-.0182
RADIUS = .700 AMPLITUDE =	-.1610	-.1734	-.0266	-.0481	.0317	-.0205	.0248	-.0180
RADIUS = .800 AMPLITUDE =	-.1513	-.1474	-.0432	-.0459	.0172	-.0162	.0182	-.0147
RADIUS = .900 AMPLITUDE =	-.1406	-.1231	-.0495	-.0377	.0044	-.0097	.0092	-.0084

Table G3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 7 with Fin Configuration 4

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.0555	-.0135	.0529	-.0068	.0202	-.0034	.0090	.0011
RADIUS = .556 AMPLITUDE =	-.1288	-.0298	.0192	.0012	.0237	-.0096	.0144	-.0083
RADIUS = .775 AMPLITUDE =	-.1423	-.0464	-.0131	-.0013	.0091	-.0005	.0063	-.0045
RADIUS = 1.017 AMPLITUDE =	-.1379	-.0591	-.0321	-.0137	-.0102	-.0060	-.0065	-.0047
RADIUS = 1.178 AMPLITUDE =	-.1379	-.0706	-.0386	-.0190	-.0112	-.0060	-.0035	.0001

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.0461	.0004	.0833	-.0206	.0058	.0115	-.0033	.0174
RADIUS = .300 AMPLITUDE =	-.0222	-.0084	.0633	-.0112	.0160	.0011	.0053	.0062
RADIUS = .400 AMPLITUDE =	-.0755	-.0170	.0455	-.0044	.0222	-.0058	.0110	-.0018
RADIUS = .500 AMPLITUDE =	-.1139	-.0253	.0283	-.0001	.0243	-.0092	.0139	-.0068
RADIUS = .600 AMPLITUDE =	-.1329	-.0335	.0115	.0014	.0210	-.0067	.0138	-.0072
RADIUS = .700 AMPLITUDE =	-.1396	-.0413	-.0037	.0005	.0144	-.0021	.0112	-.0054
RADIUS = .800 AMPLITUDE =	-.1416	-.0475	-.0156	-.0029	.0061	-.0013	.0057	-.0049
RADIUS = .900 AMPLITUDE =	-.1393	-.0523	-.0243	-.0084	-.0036	-.0041	-.0022	-.0057

Table G4 - Input Data for Wake Survey Analysis for Experiment 7 with Fin Configuration 4

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
-.7	.379	.007	.116
1.2	.387	.012	.120
2.9	.418	.022	.093
4.7	.397	.019	.101
6.6	.380	.021	.099
8.4	.393	.024	.093
10.1	.364	.029	.084
13.7	.355	.038	.075
17.3	.326	.044	.067
20.9	.308	.025	.059
37.1	.358	-.015	.028
53.2	.469	-.041	.041
69.5	.562	-.089	.063
85.7	.687	-.101	.084
102.0	.769	-.094	.114
118.2	.809	-.065	.133
134.3	.312	-.018	.140
150.5	.752	.041	.121
154.1	.726	.052	.108
157.7	.707	.057	.101
161.3	.680	.070	.081
164.9	.641	.071	.050
168.5	.617	.069	.033
172.2	.597	.068	.016
174.0	.574	.066	.008
175.7	.554	.065	.005
177.5	.548	.042	-.009
179.4	.531	.046	-.015
181.2	.552	.030	-.019
182.9	.516	.003	-.013
184.7	.522	-.012	-.014
186.6	.504	-.021	-.007
188.4	.503	-.038	-.001
190.2	.527	-.051	.009
193.7	.534	-.057	.019
197.3	.574	-.073	.029
200.8	.603	-.074	.051
204.3	.629	-.060	.067
208.0	.643	-.057	.087
211.5	.660	-.048	.095
227.7	.746	.016	.127
244.1	.760	.053	.126
260.3	.724	.079	.108
276.6	.650	.087	.075
292.8	.530	.079	.052
309.1	.434	.043	.028
325.3	.333	.001	.041
330.7	.320	-.022	.039
334.2	.319	-.029	.043
337.9	.302	-.037	.058
341.5	.315	-.047	.062
345.1	.319	-.040	.070
348.7	.336	-.034	.076
352.4	.360	-.027	.086
354.1	.355	-.022	.103
355.9	.344	-.020	.112
357.7	.367	-.006	.116
359.5	.378	.006	.110
361.4	.393	.015	.113

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
-.8	.390	-.006	.123
1.1	.387	.002	.124
2.7	.392	.004	.116
4.5	.384	.012	.098
6.3	.399	.011	.078
8.2	.398	.004	.055
10.0	.410	-.006	.051
13.5	.391	-.012	.034
17.1	.379	-.030	.019
20.7	.414	-.051	.005
24.2	.455	-.050	-.002
27.8	.481	-.080	-.013
31.3	.520	-.087	-.010
47.4	.697	-.143	-.028
63.8	.872	-.166	-.020
80.0	.936	-.147	-.001
96.2	.968	-.126	.021
112.4	.964	-.101	.046
128.8	.959	-.077	.073
144.9	.948	-.053	.094
161.1	.850	.022	.128
164.8	.788	.050	.115
168.3	.702	.070	.096
172.0	.614	.079	.040
173.8	.584	.081	.029
175.5	.556	.069	.006
177.3	.516	.070	.002
179.2	.468	.039	-.018
179.4	.466	.045	-.007
181.0	.470	.019	-.016
181.3	.459	.009	-.012
183.0	.481	-.011	-.011
184.8	.500	-.034	-.003
188.5	.556	-.053	.023
192.0	.631	-.061	.042
195.7	.695	-.054	.074
199.3	.767	-.032	.113
215.3	.865	.057	.116
231.6	.890	.081	.091
247.8	.912	.103	.067
264.0	.909	.122	.041
280.2	.886	.142	.010
296.4	.768	.151	-.004
312.5	.602	.110	-.010
328.7	.453	.056	-.001
332.3	.421	.044	.007
335.8	.411	.034	.009
339.5	.392	.019	.023
343.1	.376	.003	.041
346.6	.408	-.014	.059
350.2	.402	-.021	.071
352.1	.404	-.012	.097
353.9	.395	-.014	.112
355.7	.400	.009	.114
357.5	.397	-.008	.135
359.2	.390	-.006	.123
361.1	.387	.002	.124

Table G4 - Continued

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
-.5	.454	.017	.106
1.3	.463	.011	.108
3.1	.451	.008	.100
4.9	.440	-.006	.093
6.8	.434	-.009	.079
8.6	.431	-.015	.064
10.3	.402	-.018	.045
14.0	.432	-.058	.032
17.5	.448	-.071	.008
21.1	.466	-.091	-.006
37.3	.657	-.156	-.052
53.4	.818	-.175	-.050
69.7	.909	-.158	-.000
85.9	.928	-.134	.041
102.1	.935	-.111	.067
118.3	.945	-.091	.092
134.4	.936	-.072	.101
150.6	.942	-.050	.108
157.8	.934	-.045	.114
161.4	.936	-.041	.115
165.0	.937	-.033	.119
168.6	.950	-.019	.126
172.1	.950	.020	.136
174.0	.915	.054	.137
175.8	.848	.087	.126
177.5	.752	.097	.079
179.3	.685	.091	.043
182.9	.554	.001	.002
186.5	.597	-.082	.048
188.4	.682	-.091	.073
192.0	.785	-.066	.137
195.5	.905	.004	.140
199.0	.942	.031	.127
202.6	.943	.042	.123
206.1	.942	.047	.120
209.7	.940	.049	.117
225.8	.944	.065	.107
242.1	.942	.087	.095
258.3	.940	.107	.073
274.6	.951	.127	.047
290.8	.944	.150	.015
307.0	.886	.167	-.024
323.3	.745	.139	-.027
339.5	.597	.084	.006
343.0	.521	.065	.011
346.7	.495	.045	.026
350.3	.477	.030	.048
353.9	.458	.015	.074
355.6	.468	.008	.087
357.5	.465	.007	.099
359.2	.472	.005	.101
361.1	.475	.009	.105

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
-.8	.437	.011	-.051
1.1	.460	-.036	-.048
2.7	.474	-.053	-.045
4.5	.469	-.079	-.047
6.3	.493	-.069	-.047
8.2	.490	-.099	-.058
13.5	.517	-.110	-.076
17.1	.549	-.135	-.092
20.7	.574	-.142	-.100
24.2	.627	-.147	-.100
27.8	.650	-.164	-.104
31.3	.710	-.161	-.103
47.4	.819	-.169	-.079
63.8	.890	-.155	-.029
80.0	.917	-.129	.014
96.2	.926	-.106	.038
112.4	.928	-.081	.053
128.8	.932	-.065	.067
144.9	.927	-.044	.073
161.1	.936	-.028	.072
164.8	.934	-.027	.071
168.3	.935	-.026	.069
172.0	.928	-.021	.071
173.8	.939	-.015	.071
175.5	.943	-.002	.079
177.3	.917	.032	.102
179.2	.858	.037	.114
179.4	.825	.038	.117
181.0	.832	-.001	.106
181.3	.811	.002	.107
183.0	.831	-.029	.097
184.8	.900	-.021	.103
188.5	.920	.023	.078
192.0	.927	.028	.074
195.7	.924	.032	.075
199.3	.925	.035	.075
215.3	.931	.046	.075
231.6	.925	.066	.068
247.8	.935	.082	.055
264.0	.921	.104	.040
280.2	.936	.124	.015
296.4	.928	.147	-.015
312.5	.844	.167	-.068
328.7	.717	.159	-.084
332.3	.680	.152	-.085
335.8	.642	.147	-.072
339.5	.613	.132	-.074
346.6	.550	.116	-.046
350.2	.537	.110	-.040
352.1	.532	.096	-.042
353.9	.511	.093	-.041
355.7	.500	.081	-.043
357.5	.465	.066	-.047
359.2	.437	.011	-.051
361.1	.460	-.036	-.048

RADIUS = 1.178

ANGLE	VX/V	VT/V	VR/V
-.7	.375	-.022	-.108
1.2	.389	.001	-.106
2.9	.420	.005	-.086
4.7	.365	-.010	-.086
6.6	.336	-.050	-.103
8.4	.365	-.100	-.113
10.1	.373	-.138	-.132
13.7	.475	-.145	-.108
17.3	.525	-.167	-.068
20.9	.548	-.169	-.088

Table G4 - Continued

37.1	.709	-.187	-.060
53.2	.837	-.168	-.015
69.5	.911	-.150	.032
85.7	.923	-.118	.066
102.0	.936	-.091	.079
118.2	.928	-.071	.091
134.3	.938	-.051	.096
150.5	.932	-.034	.099
154.1	.939	-.028	.098
157.7	.957	-.022	.097
161.3	.965	-.017	.096
164.9	.959	-.015	.094
168.5	.961	-.014	.092
172.2	.963	-.013	.090
174.0	.955	-.011	.088
175.7	.947	-.009	.088
177.5	.950	-.005	.086
179.4	.950	.003	.083
181.2	.962	.007	.083
182.9	.971	.012	.083
184.7	.977	.015	.083
186.6	.966	.017	.085
188.4	.970	.018	.087
190.2	.966	.019	.088
193.7	.966	.020	.091
197.3	.966	.023	.092
200.8	.974	.025	.091
204.4	.973	.028	.091
208.0	.966	.033	.092
211.5	.973	.036	.091
227.7	.954	.054	.088
244.1	.954	.071	.082
260.3	.955	.091	.071
276.6	.957	.114	.051
292.8	.945	.143	.027
309.1	.907	.168	-.009
325.3	.778	.189	-.053
330.7	.721	.185	-.056
334.2	.670	.191	-.067
337.9	.652	.177	-.071
341.5	.583	.171	-.093
345.1	.546	.138	-.110
348.7	.459	.114	-.122
352.4	.405	.02[illegible]	-.097
354.1	.322	-.027	-.066
355.9	.332	-.045	-.064
357.7	.349	-.041	-.091
359.5	.392	-.023	-.098
361.4	.394	-.007	-.099

APPENDIX H

EXPERIMENT 8

FIN CONFIGURATION 4 (SSPA)

SHIP VALUES

Trim	3.75 ft by the stern (1.143 m)
Displacement	17,270 tons (17 550 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

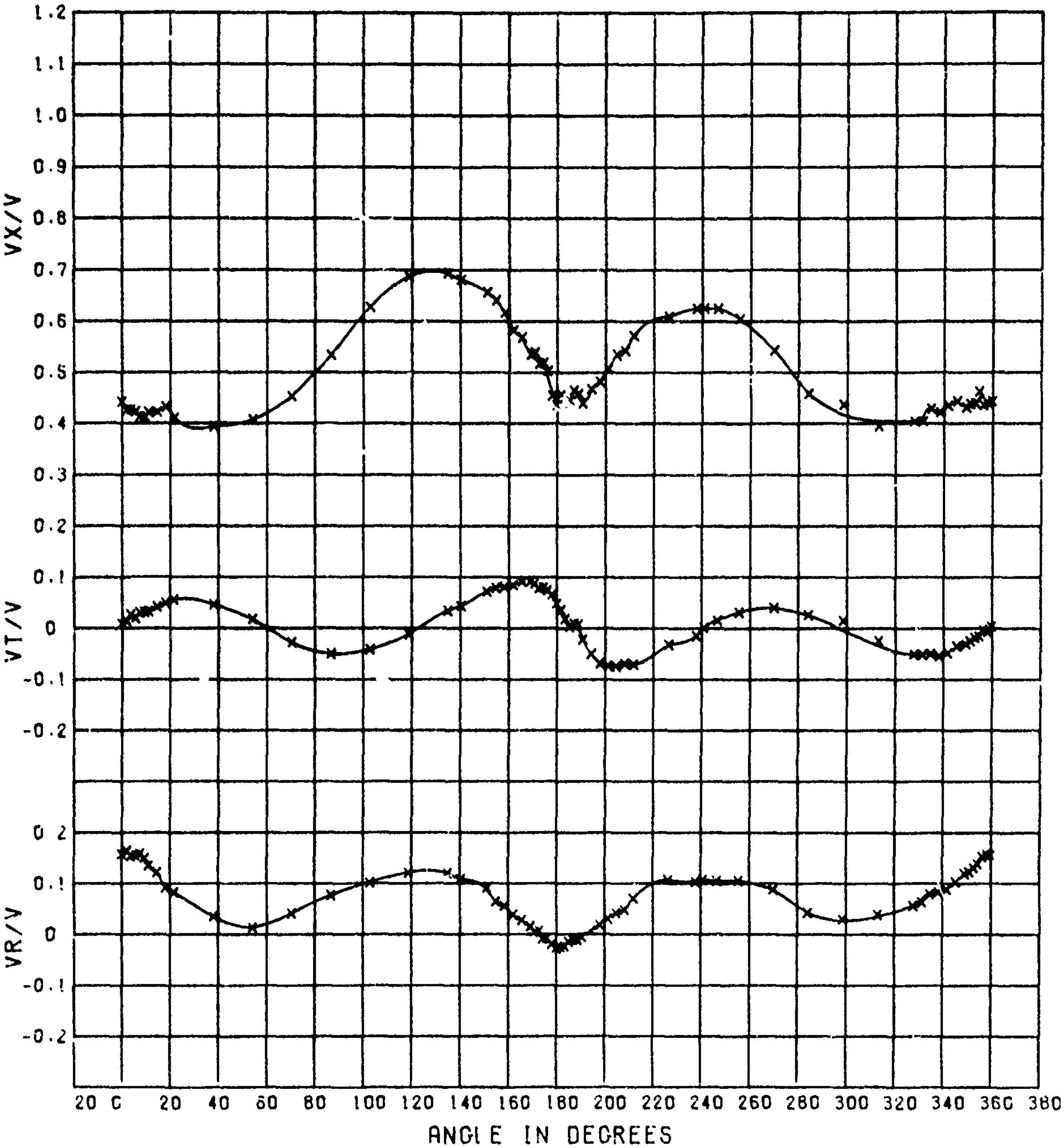


Figure H1 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 8
Radius Ratio = 0.359

Fin Configuration 4 (SSPA)
Displacement 17,270 tons (17 550 metric tons)

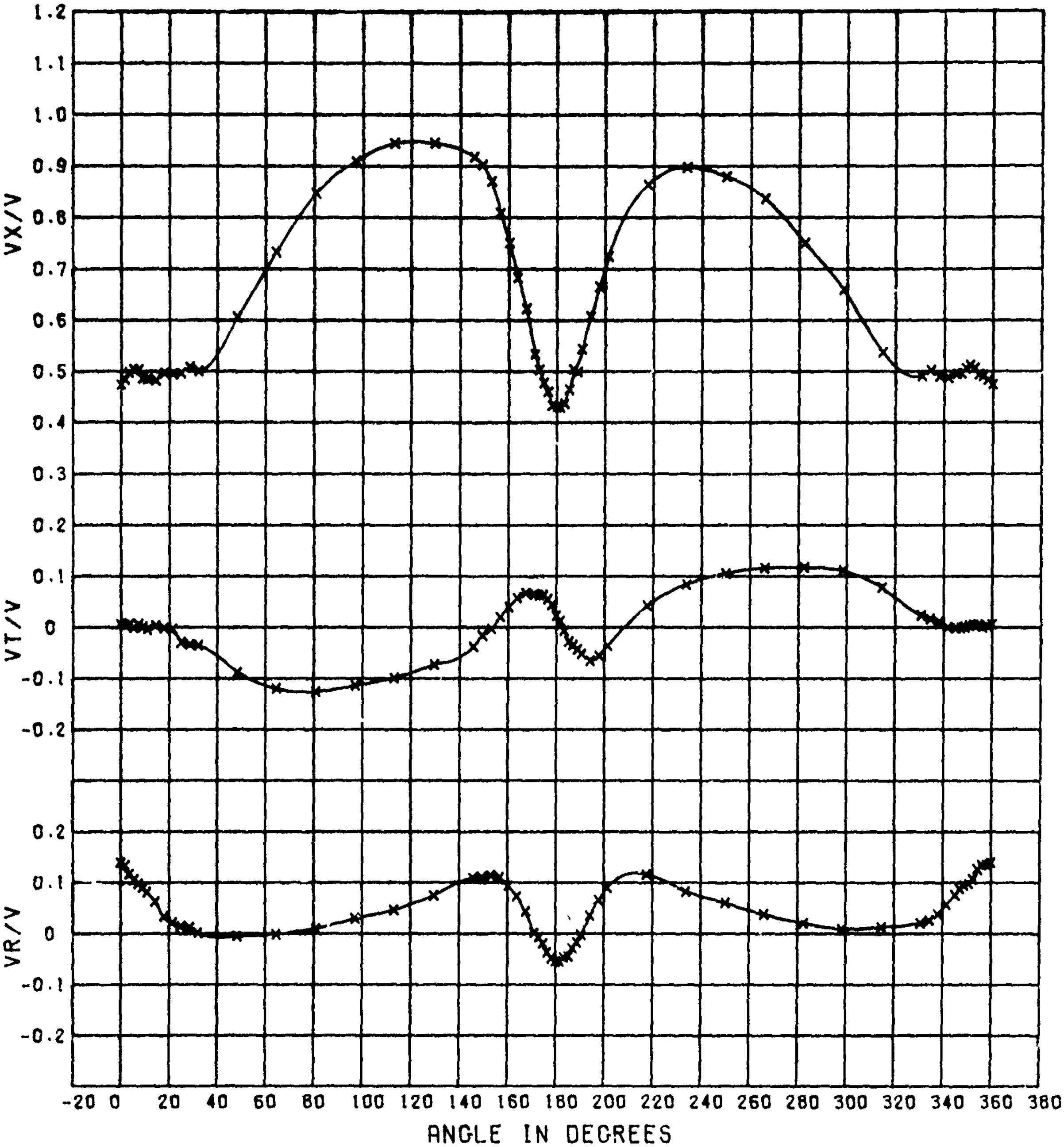


Figure H2 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 8
Radius Ratio = 0.556

Fin Configuration 4 (SSPA)
Displacement 17,270 tons (17 550 metric tons)

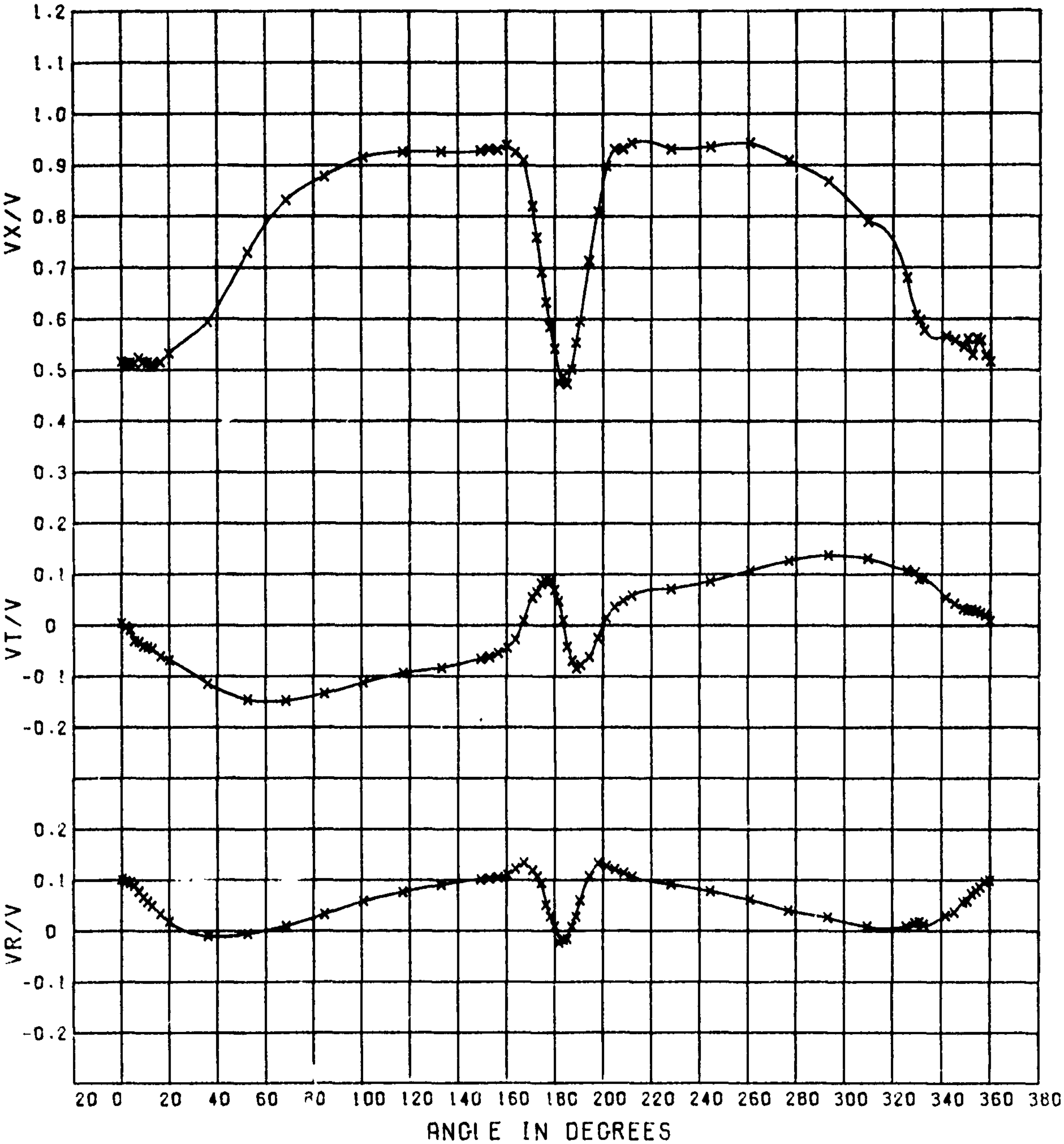


Figure H3 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 8 Radius Ratio = 0.775

Fin Configuration 4 (SSPA)
Displacement 17,270 tons (17 550 metric tons)

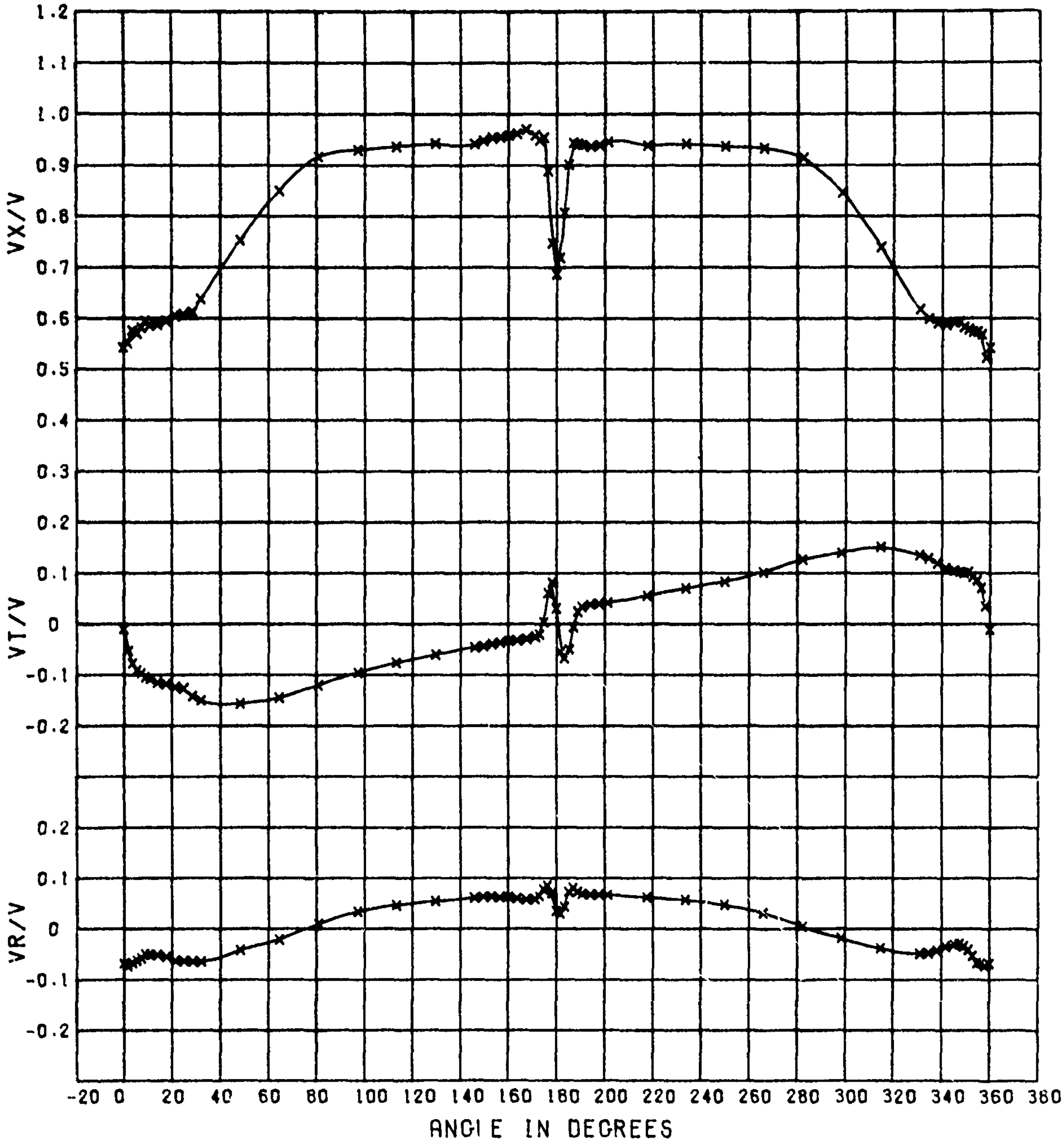


Figure H4 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 8
Radius Ratio = 1.107

Fin Configuration 4 (SSPA)
Displacement 17,270 tons (17 550 metric tons)

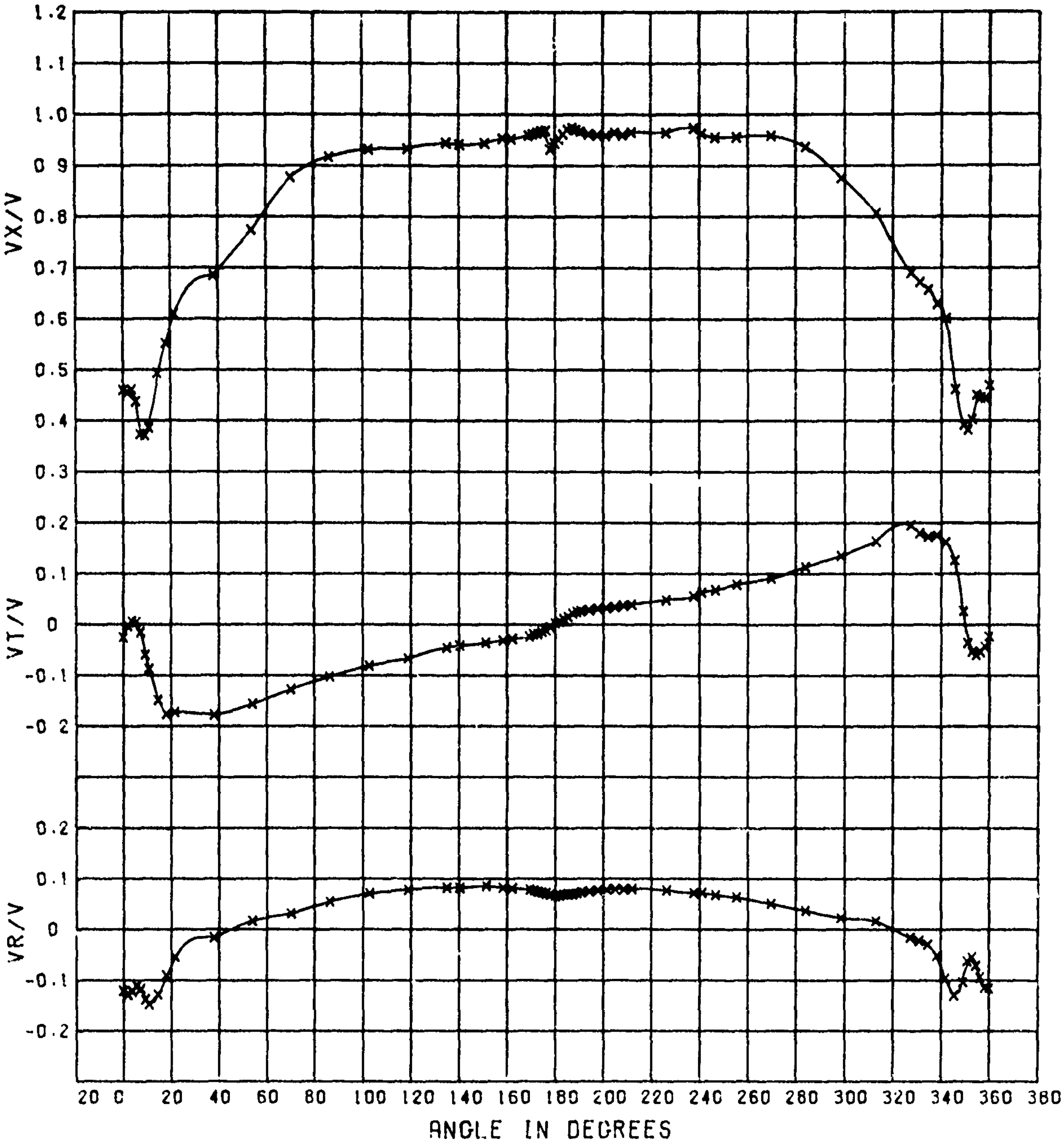


Figure H5 Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios. Experiment 8
Radius Ratio = 1.178

Fin Configuration 4 (SSPA)
Displacement 17,270 tons (17 550 metric tons)

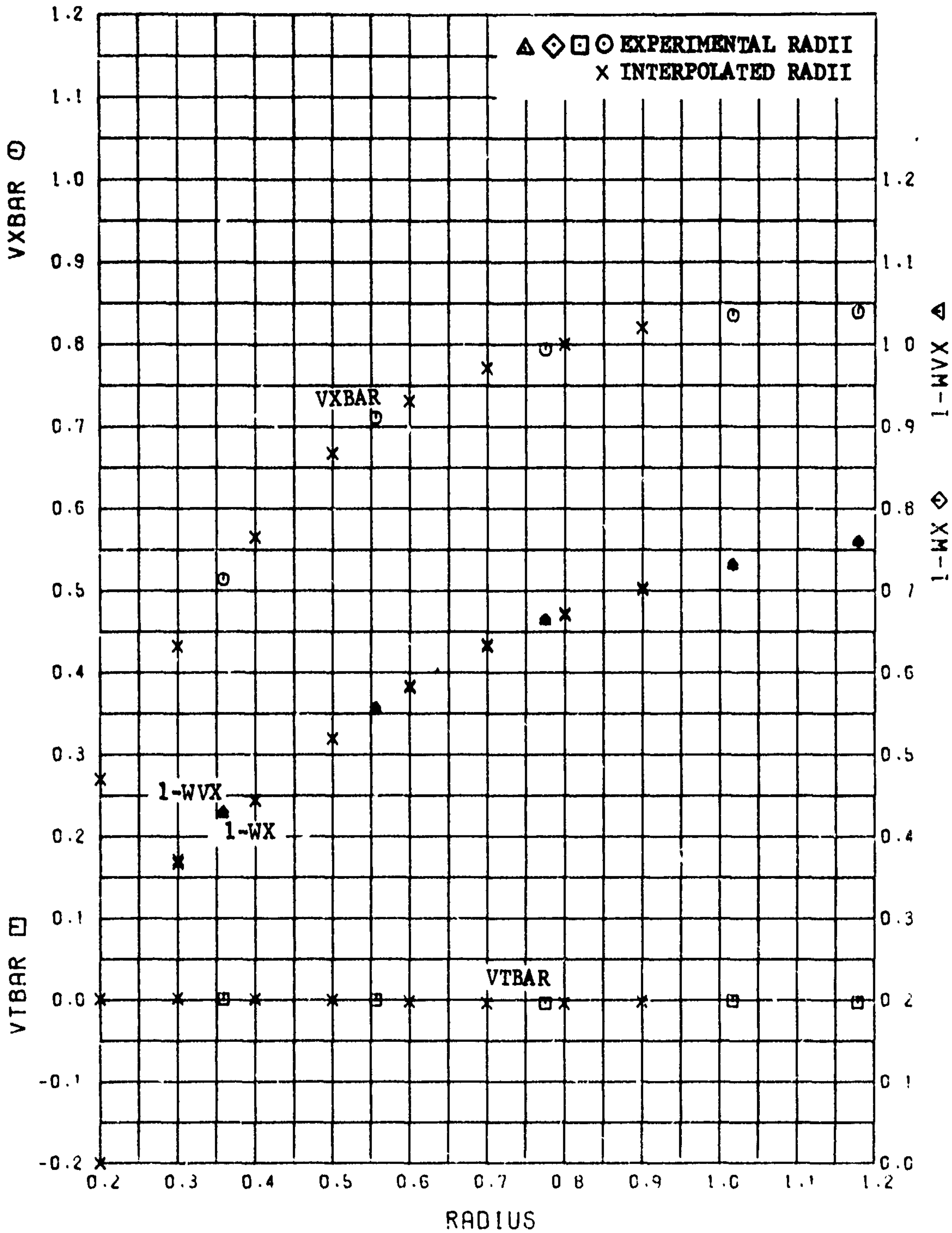


Figure H6 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 8

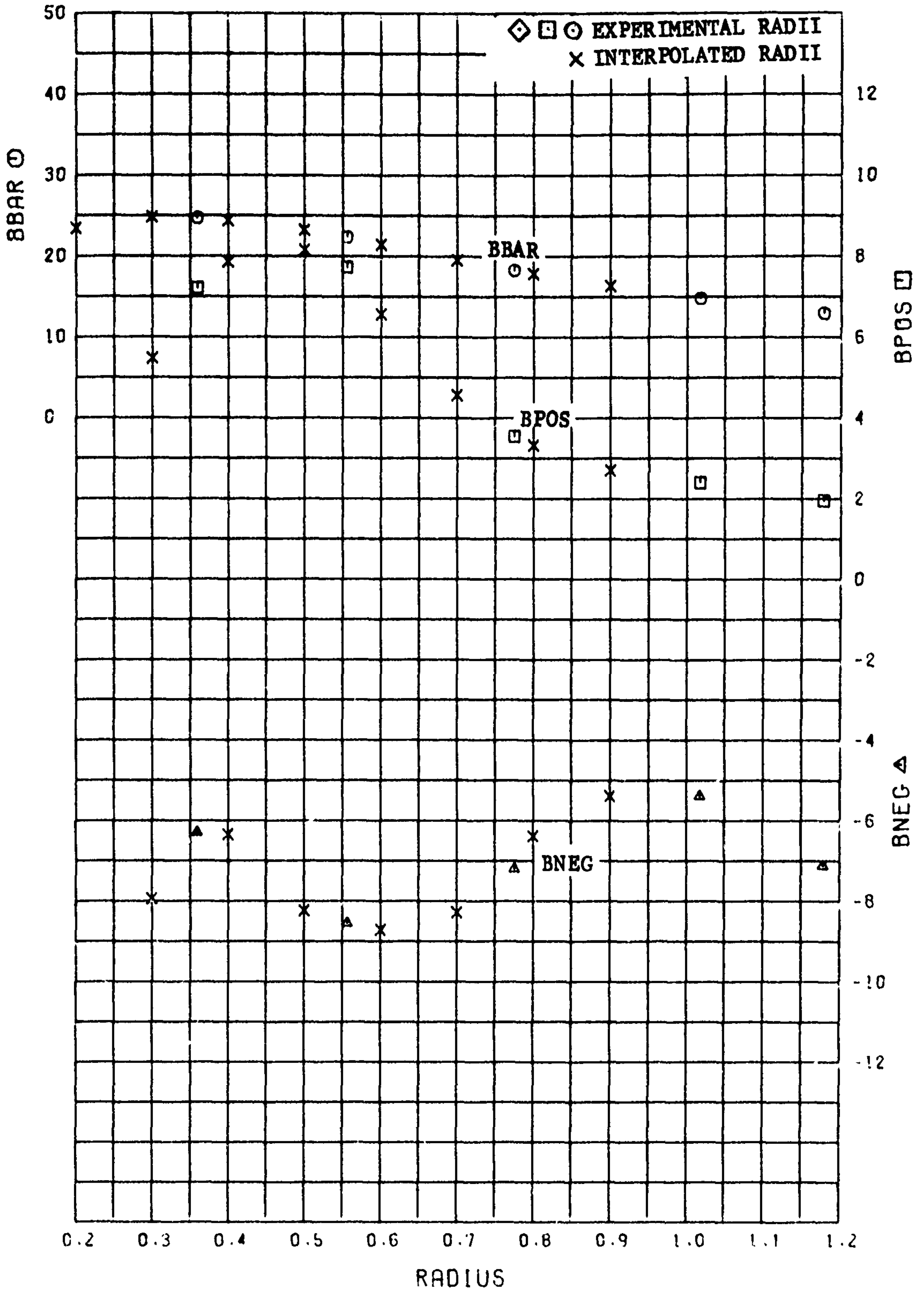


Figure H7 - Radial Distribution of the Mean Advance Angle and the Maximum Variations of the Advance Angle for Experiment 8

Table H1 - Listing of the Mean Velocity Component Ratios, the Mean Advance Angles and other Derived Quantities for Experiment 8 with Fin Configuration 4

RADIUS =	.359	.556	.775	1.017	1.178	.200	.300	.400	.500	.600	.700	.800	.900
VXBAR =	.514	.711	.794	.835	.839	.270	.432	.565	.667	.731	.771	.800	.820
VTBAR =	.001	-.000	-.004	-.001	-.003	.001	.002	.001	.000	-.002	-.004	-.004	-.002
VRBAR =	.070	.044	.053	.011	.030	.116	.085	.062	.048	.049	.055	.044	.020
1-WVX =	.427	.555	.663	.730	.759	0.000	.367	.444	.519	.582	.632	.670	.701
1-WX =	.430	.557	.665	.732	.760	0.000	.371	.445	.520	.584	.634	.672	.703
BBAR =	24.69	22.36	18.26	14.79	12.91	23.40	24.82	24.39	23.21	21.42	19.52	17.85	16.34
BPOS =	7.21	7.73	3.54	2.40	1.95	20.56	5.48	7.86	8.15	6.56	4.56	3.32	2.70
THETA =	120.00	115.00	110.00	167.50	175.00	172.50	217.50	120.00	117.50	115.00	112.50	110.00	160.00
BNEG =	-6.30	-8.56	-7.20	-5.39	-7.13	-23.74	-7.95	-6.35	-8.24	-8.72	-8.29	-6.39	-5.39
THETA =	30.00	180.00	182.50	357.50	7.50	77.50	55.00	32.50	180.00	182.50	182.50	182.50	357.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

SHIP VALUES

Trim	3.75 ft by the stern (1.143 m)
Displacement	17,270 tons (17 550 metric tons)
Propeller Diameter	21.0 ft (6.40 m)
Speed	20.0 knots
J_V	1.01

Table H2 - Harmonic Analysis of the Longitudinal Velocity Component Ratios for Experiment 8 with Fin Configuration 4

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	-.1032	-.0419	.0753	-.0136	.0079	-.0063	.0068	-.0029
RADIUS = .556 AMPLITUDE =	-.1397	-.1629	.0862	-.0367	.0517	-.0242	.0201	-.0153
RADIUS = .775 AMPLITUDE =	-.1344	-.1446	.0168	-.0443	.0419	-.0280	.0358	-.0199
RADIUS = 1.017 AMPLITUDE =	-.1629	-.0978	-.0199	-.0047	.0172	-.0047	.0105	-.0091
RADIUS = 1.178 AMPLITUDE =	-.1935	-.1133	-.0546	-.0231	-.0162	-.0161	-.0152	-.0077

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	-.0452	.1507	.0160	.0162	-.0637	.0180	-.0034	.0129
RADIUS = .300 AMPLITUDE =	-.0846	.0197	.0586	-.0037	-.0149	.0017	.0029	.0024
RADIUS = .400 AMPLITUDE =	-.1140	-.0778	.0833	-.0197	.0211	-.0112	.0095	-.0061
RADIUS = .500 AMPLITUDE =	-.1333	-.1418	.0901	-.0317	.0443	-.0205	.0162	-.0125
RADIUS = .600 AMPLITUDE =	-.1362	-.1611	.0695	-.0415	.0507	-.0268	.0262	-.0173
RADIUS = .700 AMPLITUDE =	-.1328	-.1535	.0367	-.0463	.0466	-.0293	.0346	-.0198
RADIUS = .800 AMPLITUDE =	-.1363	-.1359	.0139	-.0364	.0407	-.0233	.0339	-.0183
RADIUS = .900 AMPLITUDE =	-.1465	-.1099	.0002	-.0137	.0330	-.0099	.0247	-.0130

Table H3 - Harmonic Analysis of the Tangential Velocity Component Ratios for Experiment 8 with Fin Configuration 4

Experimental Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .359 AMPLITUDE =	.0061	-.0035	.0579	-.0077	.0092	-.0040	.0042	-.0017
RADIUS = .556 AMPLITUDE =	-.1039	-.0131	.0303	-.0063	.0224	-.0112	.0102	-.0080
RADIUS = .775 AMPLITUDE =	-.1315	-.0315	-.0048	-.0031	.0091	-.0103	.0107	-.0106
RADIUS = 1.017 AMPLITUDE =	-.1311	-.0511	-.0297	-.0099	-.0093	-.0066	-.0059	-.0056
RADIUS = 1.178 AMPLITUDE =	-.1272	-.0641	-.0408	-.0163	-.0100	.0016	.0011	.0060

Interpolated Radii

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .200 AMPLITUDE =	.1537	-.0005	.0775	-.0078	-.0187	.0074	-.0046	.0061
RADIUS = .300 AMPLITUDE =	.0548	-.0019	.0655	-.0079	.0007	-.0003	.0013	.0009
RADIUS = .400 AMPLITUDE =	-.0234	-.0049	.0525	-.0076	.0139	-.0061	.0059	-.0033
RADIUS = .500 AMPLITUDE =	-.0808	-.0097	.0385	-.0069	.0211	-.0099	.0090	-.0065
RADIUS = .600 AMPLITUDE =	-.1115	-.0169	.0223	-.0050	.0200	-.0112	.0115	-.0090
RADIUS = .700 AMPLITUDE =	-.1250	-.0253	.0059	-.0032	.0140	-.0108	.0122	-.0105
RADIUS = .800 AMPLITUDE =	-.1317	-.0335	-.0076	-.0037	.0062	-.0104	.0075	-.0108
RADIUS = .900 AMPLITUDE =	-.1321	-.0416	-.0189	-.0062	-.0030	-.0097	-.0020	-.0099

Table H4 - Input Data for Wake Survey Analysis for Experiment 8 with Fin Configuration 4

RADIUS = .359

ANGLE	VX/V	VT/V	VR/V
-.3	.443	.003	.156
0.0	.441	.015	.158
1.8	.427	.014	.164
3.5	.426	.026	.153
5.4	.423	.020	.155
7.2	.412	.031	.158
9.1	.413	.032	.150
10.8	.421	.033	.135
14.4	.422	.041	.122
18.0	.432	.049	.091
21.6	.411	.056	.082
37.9	.394	.046	.035
54.0	.407	.018	.013
70.2	.453	-.028	.041
86.4	.533	-.050	.077
102.7	.628	-.042	.101
118.8	.687	-.012	.121
135.0	.693	.034	.120
140.4	.681	.043	.108
151.1	.657	.071	.090
154.8	.641	.078	.064
158.3	.617	.081	.055
161.9	.583	.084	.038
165.5	.569	.092	.028
169.1	.535	.092	.015
170.9	.539	.087	.004
172.7	.517	.078	.006
174.5	.519	.080	-.009
176.2	.503	.074	-.008
178.1	.455	.065	-.020
179.9	.435	.048	-.028
181.7	.457	.036	-.026
183.4	.432	.018	-.024
195.2	.445	.002	-.015
187.1	.465	.009	-.011
188.9	.458	.008	-.012
190.6	.439	-.022	-.006
194.2	.468	-.050	.006
197.8	.482	-.069	.018
201.3	.507	-.074	.030
204.9	.534	-.074	.042
208.4	.543	-.069	.048
212.0	.572	-.071	.070
226.4	.609	-.032	.107
237.6	.625	-.015	.103
240.9	.625	.001	.107
246.6	.624	.015	.105
255.4	.605	.031	.105
269.7	.542	.040	.088
284.1	.458	.026	.042
331.0	.404	-.052	.063
327.4	.404	-.051	.056
312.9	.394	-.025	.038
298.5	.437	.015	.030
334.5	.428	-.050	.079
338.2	.422	-.055	.083
341.8	.435	-.049	.088
345.4	.444	-.035	.103
349.0	.431	-.031	.119
350.8	.439	-.025	.123
352.6	.439	-.019	.131
354.4	.462	-.016	.138
356.1	.436	-.003	.152
358.0	.436	-.006	.153
358.0	.442	-.009	.161
359.7	.443	.003	.156
361.8	.427	.014	.164

RADIUS = .556

ANGLE	VX/V	VT/V	VR/V
-.2	.474	.006	.139
1.6	.484	.004	.134
3.3	.494	.009	.116
3.3	.500	.003	.117
5.1	.500	-.002	.110
5.1	.507	.000	.102
7.0	.504	.005	.097
8.7	.486	.000	.089
10.6	.484	-.004	.081
14.1	.482	.003	.062
17.7	.496	-.002	.033
21.3	.495	-.004	.021
24.8	.496	-.030	.014
28.4	.508	-.034	.011
32.0	.501	-.036	.001
48.2	.607	-.089	-.006
64.5	.733	-.121	-.002
80.7	.847	-.127	.009
97.0	.909	-.114	.029
113.1	.944	-.100	.046
129.5	.944	-.073	.074
145.7	.917	-.038	.109
149.3	.902	-.017	.111
152.9	.870	-.003	.114
156.5	.809	.020	.110
160.2	.750	.040	.094
163.7	.683	.058	.073
167.4	.623	.066	.043
171.0	.533	.065	.001
172.7	.503	.063	-.008
174.6	.477	.063	-.020
176.3	.460	.055	-.037
178.1	.433	.044	-.049
179.8	.426	.023	-.058
180.0	.435	.021	-.052
181.6	.429	.012	-.055
183.3	.437	-.007	-.047
185.1	.465	-.028	-.045
186.9	.504	-.035	-.029
188.8	.499	-.044	-.018
190.5	.544	-.053	-.003
194.1	.608	-.066	.035
197.7	.666	-.056	.066
201.3	.725	-.036	.090
217.6	.864	.042	.116
233.7	.897	.084	.082
250.0	.879	.105	.060
266.1	.837	.115	.037
282.3	.749	.117	.021

298.5	.659	.111	.009
314.8	.536	.078	.012
330.9	.491	.025	.021
330.9	.490	.021	.020
334.5	.502	.016	.025
338.1	.489	.010	.038
341.7	.487	-.000	.056
345.3	.495	-.002	.075
347.2	.495	-.002	.087
348.9	.506	.001	.095
350.7	.511	.003	.098
352.5	.506	.004	.107
354.4	.493	.005	.126
356.1	.490	-.000	.135
358.0	.482	.002	.135
359.8	.474	.006	.139
361.6	.484	.004	.134

RADIUS = .775

ANGLE	VX/V	VT/V	VR/V
-.2	.516	.008	.099
0.0	.515	-.001	.102
1.8	.512	-.003	.098
3.5	.513	-.009	.095
5.3	.512	-.032	.088
7.2	.522	-.033	.077
9.0	.516	-.041	.066
10.8	.514	-.043	.057
12.6	.512	-.046	.049
16.2	.515	-.061	.033
19.9	.532	-.068	.018
36.0	.594	-.115	-.011
52.3	.729	-.146	-.006
68.4	.832	-.149	.009
84.6	.878	-.135	.033
100.9	.916	-.113	.058
117.1	.926	-.095	.076
133.2	.927	-.084	.090
149.4	.928	-.066	.101
153.0	.932	-.062	.103
156.5	.930	-.054	.105
160.2	.939	-.044	.110
163.7	.925	-.028	.122
167.3	.910	.009	.134
170.9	.819	.054	.119
172.7	.759	.065	.107
174.6	.692	.083	.094
176.3	.633	.087	.051
178.1	.585	.086	.028
179.9	.541	.069	.008
181.7	.476	.047	-.023
183.5	.488	.010	-.017
185.2	.469	-.038	-.018
185.2	.476	-.047	-.015
187.1	.501	-.070	.008
188.9	.554	-.085	.028
190.6	.596	-.078	.060
194.2	.713	-.062	.107
197.8	.809	-.025	.133
201.4	.899	.014	.128
204.9	.931	.036	.121
208.5	.932	.048	.114
212.0	.943	.059	.107
228.2	.932	.071	.092
244.5	.936	.086	.078
260.7	.943	.107	.062
276.9	.909	.126	.040
293.1	.868	.137	.026
309.4	.789	.131	.009
325.7	.680	.108	.009
329.2	.607	.104	.015
331.0	.597	.091	.017
332.8	.577	.091	.012
341.8	.566	.055	.030
345.4	.558	.042	.036
349.0	.546	.032	.057
350.7	.561	.030	.059
352.6	.529	.031	.072
354.5	.561	.029	.078
356.1	.558	.023	.086
358.0	.528	.020	.097
359.8	.516	.008	.099
361.6	.524	.007	.097

RADIUS = 1.017

ANGLE	VX/V	VT/V	VR/V
-.2	.542	-.011	-.069
1.6	.550	-.053	-.073
3.3	.580	-.074	-.070
3.3	.571	-.081	-.065
5.1	.568	-.094	-.060
5.1	.573	-.089	-.064
7.0	.582	-.098	-.058
8.7	.595	-.106	-.051
10.6	.596	-.108	-.051
14.1	.588	-.116	-.052
17.7	.594	-.119	-.055
21.3	.605	-.124	-.063
24.8	.608	-.127	-.063
28.4	.612	-.143	-.065
32.0	.638	-.151	-.065
48.2	.753	-.157	-.042
64.5	.850	-.146	-.022
80.7	.916	-.121	.009
97.0	.929	-.096	.033
113.1	.936	-.077	.046
129.5	.943	-.061	.054
145.7	.942	-.047	.060
149.3	.948	-.044	.063
152.9	.953	-.040	.064
156.5	.955	-.037	.061
160.2	.958	-.033	.062
163.7	.962	-.032	.060
167.4	.970	-.030	.057
171.0	.958	-.025	.058
172.7	.949	-.021	.065
174.6	.954	.003	.078
176.3	.889	.061	.085
178.1	.747	.081	.070
179.8	.693	.030	.039
180.0	.679	.031	.030
181.6	.718	-.055	.029
183.3	.807	-.068	.043
185.1	.901	-.050	.072
186.9	.944	-.007	.080
188.3	.940	.023	.073

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